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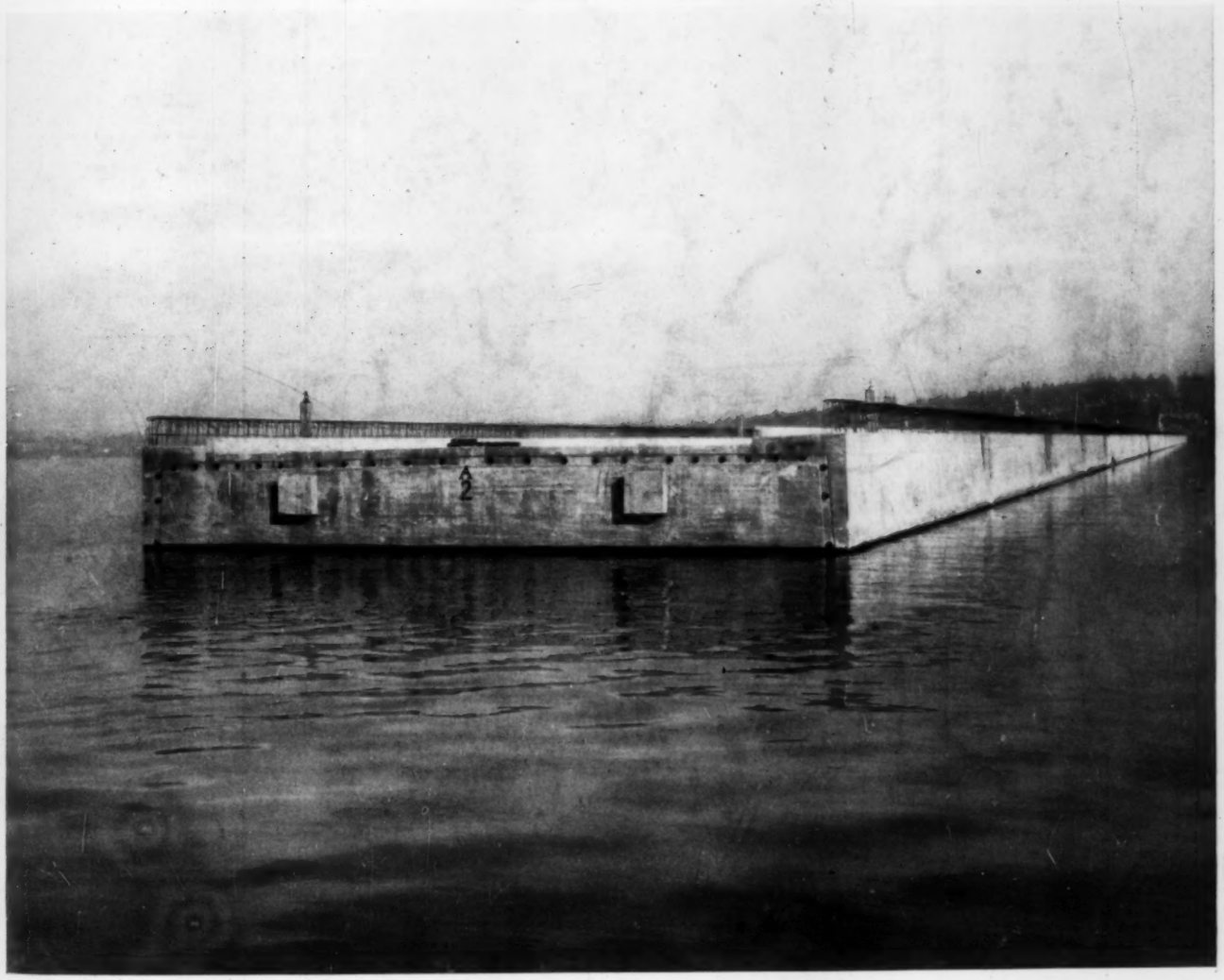

THE MILE-AND-A-QUARTER-LONG FLOATING ROADWAY OVER LAKE WASHINGTON TAKES FORM
Methods of Constructing and Anchoring the Pontoons Are Described in This Issue

Volume 10 — *Number 1*

JANUARY 1940

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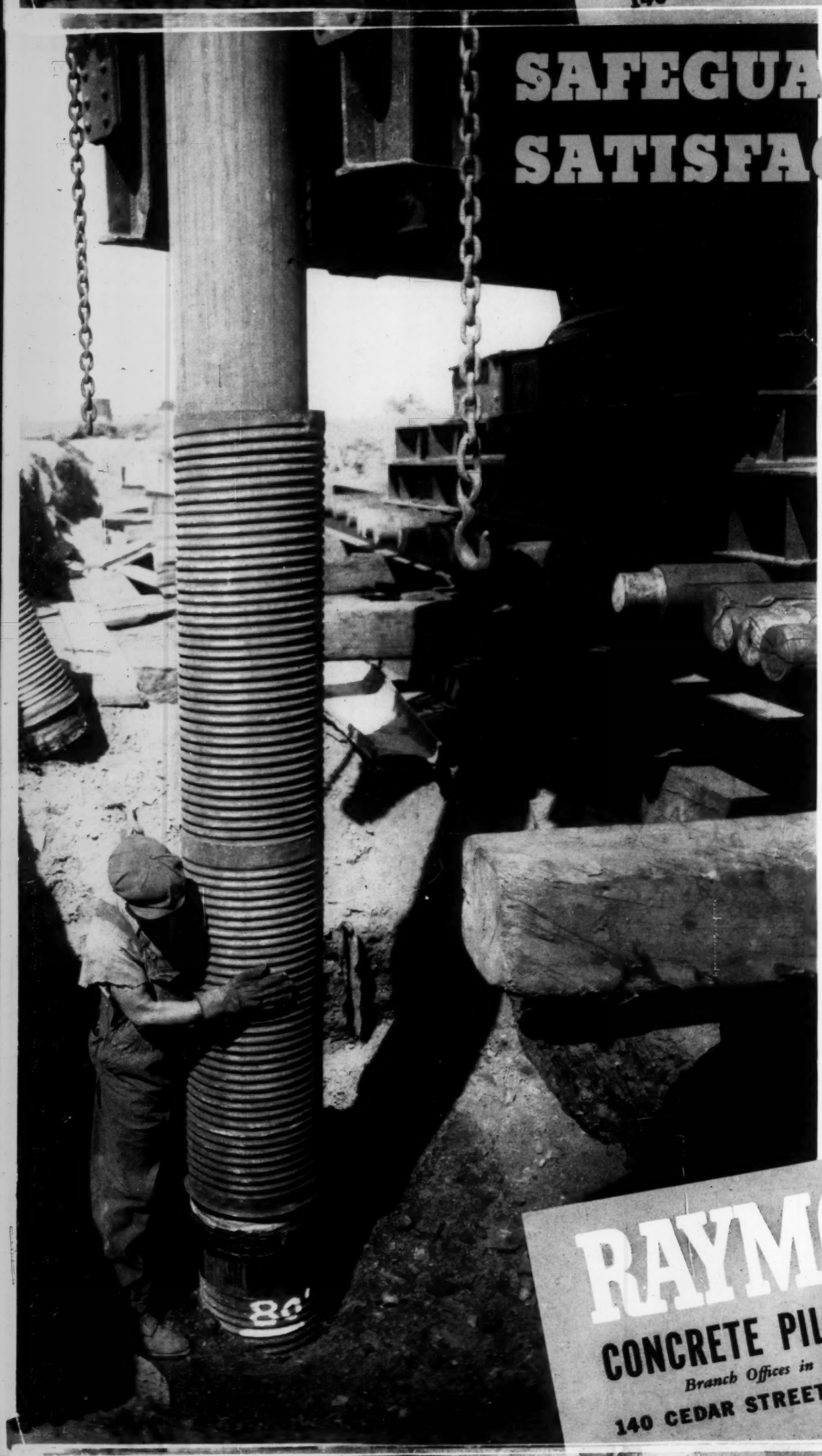

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R. R. MARTEL (Brown '12) joined the faculty of the California Institute of Technology in 1918. Since 1930 he has been Professor of Structural Engineering. He visited Japan on two occasions to study earthquake forces; and for some years he has been active in the development of appropriate structural safeguards on the West Coast.

L. DEMING TILTON (U. of Ill., '15) was director of planning, Santa Barbara County, California, 1929–1932, and since then has been planning consultant for various California counties, for the State Planning Board, the National Resources Planning Board, and the Haynes Foundation.

L. W. HALL (U. of Okla., '24) has been for 14 years with the Arkansas Highway Department, including 5 years on design of highways as district chief draftsman and 8 years on construction as resident engineer.

CHARLES E. ANDREW (U. of Ill.) after 13 years of miscellaneous engineering work, became bridge engineer for the State of Washington in 1921. In 1927 he went to work for the State of California in the same capacity. He was in charge of design and construction on the San Francisco–Oakland Bay Bridge.

O. H. AMMANN (Swiss Federal Poly. Inst., '02) was principal assistant to Gustav Lindenthal early in the century. In 1925 he became chief engineer of bridges, and in 1937 director of engineering, for the Port of New York Authority. He also acted as consultant on the Golden Gate Bridge and since 1934 as chief engineer of the Triborough Bridge Authority.

IRA D. S. KELLY was for two years a structural engineer with National Lumber Manufacturers Association and its subsidiary, the Timber Engineering Co. of Washington, D.C. Previous experience included 11 years on highway and bridge work, and he is now a senior engineer with the Kansas State Highway Commission.

CLYDE W. WOOD is president of the Metropolitan Construction Co. (Los Angeles), of Clyde W. Wood, Inc., and of the Wood Road Mixer Co., and is treasurer and member of the executive committee of Pacific Constructors, Inc. With almost 30 years of construction experience, he has invented and developed a variety of labor-saving equipment for both canal and road building.

LEON S. MOISSEIFF (Columbia U., '95) was with the Department of Bridges, City of New York, from 1897 to 1915. Since then he has maintained a consulting practice, specializing in bridges and structures. He developed the deflection theory of suspension bridges and was the first to introduce it into actual design.

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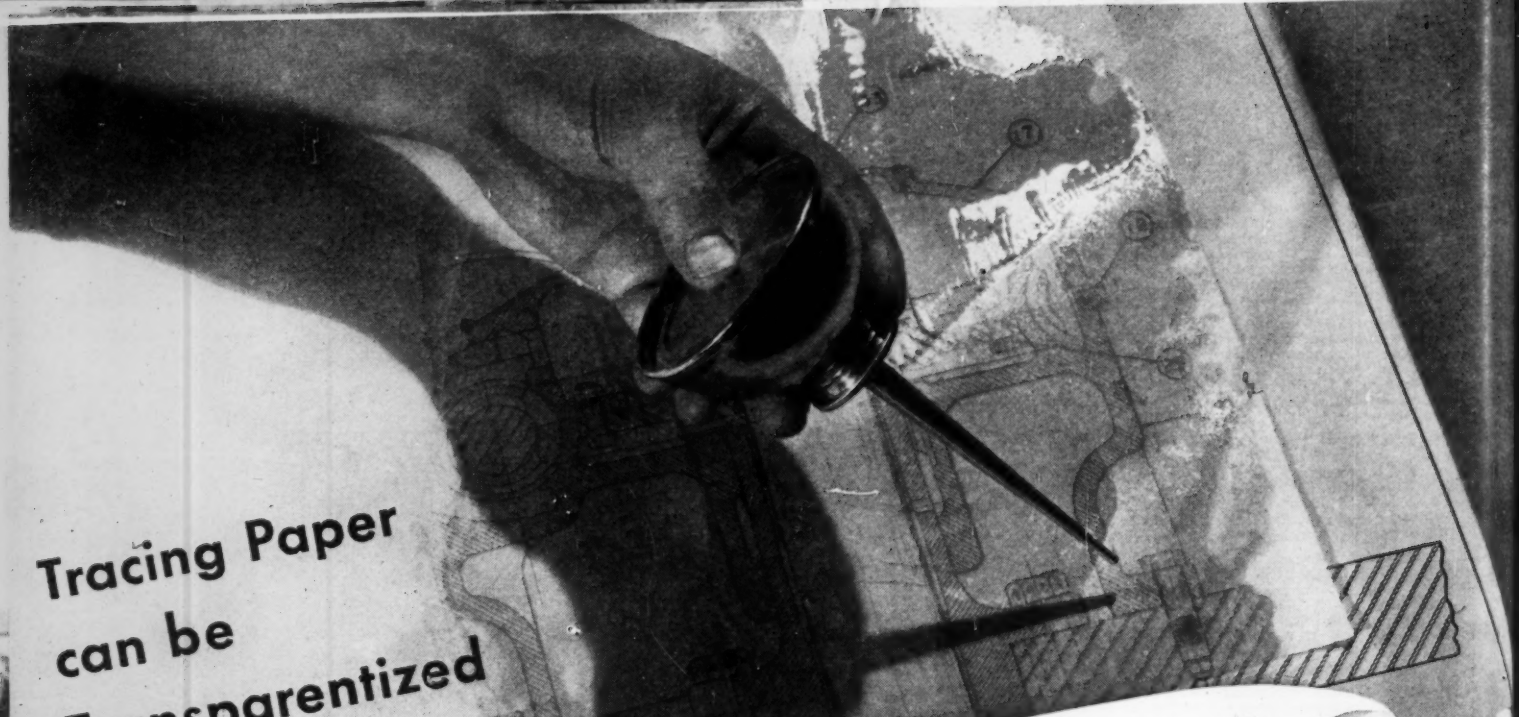

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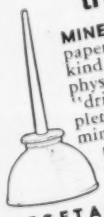

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THE STABILIZED TRACING PAPER

Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

The Engineer and Public Service

Abridgment of Talk Before University of Cincinnati Student Chapter of the Society

By HENRY G. HODGES

ASSOCIATE PROFESSOR OF POLITICAL SCIENCE, AND COORDINATOR, GRADUATE TRAINING IN PUBLIC ADMINISTRATION, UNIVERSITY OF CINCINNATI, CINCINNATI OHIO

THE increasing complexity of modern life since the turn of the century, and even before, has changed the emphasis of government from preservation of law and order to social control. With this change, the engineer has come to play an ever-increasing role in the public service. Our older governments—national, state, and local—were policing agencies. Few of us realize the developments in public administration of the past two or three generations. Even those who devote their major energies to this field are often surprised at the picture of kaleidoscopic changes presented by their studies. The Cincinnati city government, for example, started in 1802 with 21 activities; these steadily increased until they numbered 256 at the end of 1936.

Public Functions Multiplied.—We are amazed not only by the increases in the number of governmental functions, but by their ever-growing intensity and intricacy from both the social and the engineering standpoints. The Cincinnati study shows, for instance, that between 1830 and 1845, while real estate values doubled, the cost of administering municipal activities increased fivefold. Over a longer range, the per capita costs jumped from about $1.75 in 1837 to approximately $25.50 in 1937. The significant factor is that this tempo has been noticeably faster since 1900, and promises to continue its acceleration as modern inventions supply opportunities for an ever higher standard of group living, and our citizens continue their demand that new social and engineering opportunities be translated into community services.

The governments of large cities have social obligations which come only with concentrated populations. Better living standards are reflected in increasing public functions, resulting in high per capita costs and an ever greater demand for skill in the public service. Engineers of the present generation must develop a much more social point of view than their predecessors if they have any intention of attempting to fulfil their professional obligations in a democracy. I wonder if the lawyer is not going to give way to the engineer and the economist in the field of public service? The legal approach to new social and economic problems has suffered from that "backward vision" which is stimulated in lawyers by their worship of precedents, some of which are only neo-medieval. Such dusty answers have not yielded satisfactory solutions to the modern problems of government. The engineer in public service must have a spark of that same creative force which motivated Edison and Steinmetz in the scientific field. If service to society had been the measure of their personal reimbursement, at what figure would we have calculated their riches?

Some Complications to Be Solved.—What problems future trends will present to government can be only guessed, but these are submitted as probable:

1. We are approaching the time of maximum population.
2. The average age of citizens will continue to increase.
3. Increasing leisure will foster new and improved plans in recreation and adult education.
4. Improved transportation will decrease the congestion of our cities.
5. Better housing will change the emphasis on health and crime problems.
6. Population distribution between urban and rural districts will swing back and forth across the balance demanded by economic considerations.

If any considerable number of these predictions are in line, is it not perfectly clear that the engineer with a civic vision is going to play a major part in providing the necessary solutions? Possibly he will consider the challenge more worth while when he learns that his chief reward will be in the personal satisfaction of his contribution. Transition to this point of view is not going to be easy, because the neophytes in engineering have been told for years that the great prizes lay with large private corporations where monetary reward has been the criterion. Whatever the social approach adopted by the

engineers of the future, it is clear that to their profession will be entrusted heavy responsibility for the proper performance of many of the activities of government, as well as the solutions for its growing problems.

Better Training for Public Duties.—Civil engineers have not shunned public employment. As of January 1, 1935, the U.S. Department of Labor claimed that 63.3 per cent of the profession were in that field. How much larger would the percentage be if we included those engineers working for private contractors engaged almost exclusively on public work? And how much larger must it grow in the near future, if democracy is to defend itself by a more efficient performance in an increasing number of its governmental activities? Again, how will these percentages be affected by the steady trend toward government ownership and operation of activities which the courts have described as "affected with a public interest"? The answers must be based on those social considerations which are finding their solutions in an economic interpretation of politics—and not on any mechanical, slide-rule method.

Since the profession is so vitally connected with the public service, does it not seem a dereliction of duty that most engineering schools include nothing concerning government or public administration in their curricula? An engineer working for a private utility could well use knowledge of that field of government known as public regulation of utilities. If he properly senses future trends, he will keep a cautious eye on those factors which make up his rate base, and see that it does not become loaded with items that might be construed as not "used or usable" in the business. So we could go on and on, showing the direct relation between the work of the engineering professions and those principles covered by various subjects in the general field of public administration.

Stimulating Higher Standards.—As a professional group, and as citizens, engineers have a special duty to lend their support at every opportunity for promoting the merit principle in government employment. By taking this stand, as individuals and as societies, they will be simply preparing in advance the bed in which, in an ever-increasing number, they must eventually lie. Organized engineering groups have considerable influence in guiding public policies, but they will have to put themselves on record, and in unmistakable terms. Those who have devoted a proper attention to government in their training period will know that there is a world of difference between civil service and lip service. Not only must they guard the merit principle in its adoption and operation, but they must be interested enough to see to it that the best personnel techniques are put into operation. In particular, I would suggest an interest in improving the back door of public personnel management, so that government can be more easily relieved of those who have become permanently fatigued or soured by service. In other words, civil service should not be allowed to become a burying ground for ex-soldiers, or an institution to develop civil soldiers. Engineers might also interest themselves in fostering proper work incentives in the public service. Public employees should be encouraged to take university courses in their field, for credit on their service ratings.

Under proper conditions, we will continually work toward that goal where the best shall serve the state. With the increasing complexity of the social services assigned to public administration we will be compelled to seek that objective, unless we are satisfied to substitute some dictatorial form for democratic government. Administrative techniques in the field are twenty years ahead of accepted practice! General adult education on this subject, fostered especially by engineering societies, may save all of us some painful experiences, by compelling a shortening of this gap between the used and usable in administrative practices.

Public Service, Good or Bad?—Next to religion, government affects all of us more directly than any other force. It follows us, especially local government, from the registration of our birth certificate to the issuance of the permit for our burial. Between these important milestones of our existence, it guards us against dangerous foods, drinks, and building conditions. It furnishes our highways; it supplies our water, recreation, education, and justice; it cares for those of us who are too poor to take care of ourselves; and finally, it regulates those private utilities which supply many of the essentials of our daily life. All these services can be rendered in a good, bad, or indifferent manner, and at prices we can or cannot afford to pay. In proportion as these services and their costs are salutary and within our financial ability to enjoy, our lives, especially in cities, are either happy or unhappy, and consequently fruitful or barren.

As our knowledge of public affairs becomes broader, we increasingly demand the best in both public services and their costs. Democratic government must be more efficient in the future, and most of the burden for making it so rests on the various branches of the engineering profession. The exigencies of congested living conditions are not solved by declaiming about a heroic past.

To Develop Trained Administrators.—Our democratic determination of governmental policies and their administration will be saved by advances along two principal lines. Improvement in public administration will be the more important. The other requirement is more adult education, through public forums and in other ways, in social, economic, and political problems. A democratic electorate can intelligently determine public policies only when it possesses the necessary factual background on which political literacy is predicated. Our word "legislature" is a substitution for the older term "parliament," derived from the French *parler*, which means to discuss or talk about. "Council" is a term which explains itself as a representative body which should arrive at wise conclusions through discussion. But how can the conclusions of discussion result in wisdom if the lack of political intelligence reduces it to the status of mere babble?

Wise governmental policies proceed from intelligent public and legislative discussion, and good management within such policies results from the public employment of trained administrators. For a large part of the field of public administration, the techniques of the various branches of engineering are underlying prerequisites. The engineer's professional interest in public service can have a marked influence in preserving democracy by making its administration more effective.

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NUMBER 1

Lake Michigan Water for Grand Rapids, Mich.

Thirty-Mile Pipe Line and Two High-Head Pumping Plants Are Major Features of New 55-Mgd Project

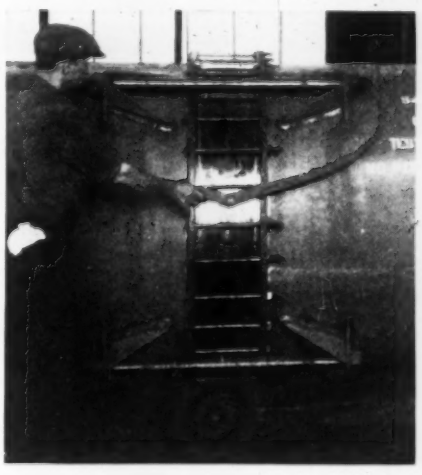
By ARTHUR WARDEL CONSOER, M. AM. SOC. C.E.
CONSOER, TOWNSEND AND QUINLAN, CONSULTING ENGINEERS, CHICAGO, ILL.
and JOHN A. FULKMAN, M. AM. SOC. C.E.
HYDRAULIC ENGINEER, CONSOER, TOWNSEND AND QUINLAN, CHICAGO, ILL.

TO replace a water supply that was rapidly being outgrown, the city of Grand Rapids, Mich., now has under construction a $4,100,000 project to bring water from Lake Michigan, thirty miles away. It is scheduled for completion in May of this year. Because of the high pumping head involved, emphasis has been placed on efficiency in all features of the design, and many combinations of pipe diameter and reservoir capacity were studied in order to arrive at the most economical set-up with respect to total annual cost. A general history and description of the project are given by Messrs. Consoer and Fulkman in the accompanying article.

FOR several decades municipal officials of Grand Rapids, Mich., have been endeavoring to obtain a Lake Michigan municipal water supply. In 1899 Allen Hazen and Samuel M. Gray, late Members Am. Soc. C.E., were engaged to report on Lake Michigan as a source of supply in comparison with other available sources. Because of the very high cost involved in constructing 30 miles of pipe line, and because of the availability of a supply from the Grand River sufficient for the city's requirements at that time and, for a reasonable number of years in the future, Hazen and Gray properly recommended the Grand River as the source of supply, together with rapid sand filtration. The Grand River supply was developed accordingly; the filtration plant, built in 1912 and enlarged in 1922, at present serves as a partial softening and filtration plant.

For the past ten years it has become increasingly apparent that the Grand River water supply was becoming inadequate for current needs and that a new supply would have to be developed. In the summer of 1936, it was necessary to close the cooling-water intake of the Consumers Power Company at Grand Rapids and even then the supply was not sufficient to meet full municipal demands.

People were also objecting to the strong chlorine taste in the water as a result of heavy chlorine residuals which were necessitated by upstream contamination. Furthermore, incrustation in water mains, heating systems, and plumbing systems with the use of Grand River water was steadily increasing and was objectionable from many standpoints.



THIS SAND-PROOF JOINT, SPECIALLY DEVELOPED FOR LAKE INTAKE LINE, SUCCESSFULLY WITHSTOOD A TEST PRESSURE OF 300 LB PER SQ IN.

In June 1938, when the current relief bill was passed by Congress, city officials, headed by Mayor George Welsh, immediately perceived their opportunity to secure a Lake Michigan water supply. The authors' firm was engaged to make a preliminary study and report on the advisability of the project.

Analyses showed that with chlorination and filtration a highly satisfactory water could be obtained from Lake Michigan. Table I gives comparative analyses for the two supplies. In addition to the factors shown there, it should be pointed out that the raw river water is highly turbid, while there is practically no turbidity in the raw Lake Michigan water at the proposed intake location.

After a careful study, the engineers recommended to the city of Grand Rapids that the development of the lake supply was very desirable and economically feasible, providing a PWA grant could be obtained. The total estimated cost of the project, including lake intake, pipe line, pumping stations, reservoirs, and auxiliary distribution mains, totaled $4,100,000. The city administration filed an application for a PWA grant of $1,845,000 in September 1938, and notice of the grant was received the following month.

One of the stipulations of the grant was that the project be completed in June 1940, so it was necessary for work to get under way very rapidly. The first contract was let November 15, 1938, and the nineteenth and last contract was let October 2, 1939, with the scheduled date of completion set for May 25, 1940.

The new system will consist of a submerged wooden intake crib located

AT WORK ON THE GRAND RIVER CROSSING OF THE PIPE LINE

6,000 ft from the Lake Michigan shore, about 30 miles due west from Grand Rapids; a steel intake line; 30.6 miles of reinforced concrete pipe; two high-head pumping stations; two covered underground reservoirs in Grand Rapids of a total capacity of 24 million gal, with pumps and control equipment; and feeder mains of various sizes within the city.

As a WPA project the city recently completed a new 16-million-gal reservoir which will be incorporated in the system. It also has under construction 22,000 ft of 42 and 36-in. cement-lined, bitumastic-coated steel pipe as a feeder main for that reservoir. At present there is a total of 3 million gal of reservoir capacity floating on the high pressure system. With both projects completed there will be a total reservoir capacity of 43 million gal in Grand Rapids.

CAPACITY STUDIES FOR THE NEW SYSTEM

After an extended study of population trends as well as records of daily demand and pumpage, it was decided to design the new system to provide for a 50% increase in the daily demand over a period of the three greatest demand months heretofore experienced. The records for the months of July, August, and September of 1936 showed a series of daily demands far above any ever before experienced. Accordingly, the water consumption for each day of these maximum three months was increased by 50%, giving the basis of design of reservoir capacity and pipe-line size. It is felt that this design will provide adequate facilities until the year 1970, the anticipated population at that time being 250,000 as compared with a present population of 170,000. Up to the present time, the maximum daily average pumpage in any one year has been 18.6 mgd. Future estimated daily average pumpage over a period of a year is 28 mgd. The new system is designed to permit a maximum daily pumpage of 55 mgd.

TABLE I. COMPARATIVE ANALYSES OF PRESENT (GRAND RIVER) AND PROPOSED (LAKE MICHIGAN) WATER SUPPLIES FOR GRAND RAPIDS, MICH.

	Lake Michigan		Grand River	
	Average Raw	Average Filtered	Average Raw	Filtered and Softened (1933–1937, incl.)
Temperature, Fahrenheit	52 (at 45-ft depth)		33–84 (variable)	
Reaction, pH	8.0	7.5	...	8.9
Carbonate hardness (alkalinity), ppm.	113	109	208	49
Non-carbonate hardness (incrustants), ppm.	14	17	84	75
Total hardness, ppm.	127	126	292	124
Total solids, ppm	145	145	356	191
Oxygen consumed, ppm.	1.5	1.4	8.2	2.9
Color (A.W.W.A. standard)	12.0	Trace	28.0	5.0

By means of fill and draw diagrams it was determined that with a maximum pumping rate of 50 million gal per day, and for the design conditions as already outlined, the minimum residual in the reservoirs at any time would be 21 million gal. This condition would exist for one day only; on all other days any desired storage from 31 to 43 million gal could be maintained in Grand Rapids.

With the new water supply system, a long intake and 30 miles of pipe line with an elevation head of 175 ft will replace a short intake to the Grand River and ordinary low-lift pumps. This means a substantial increase in pumping costs. Therefore, it was important throughout the entire design to place emphasis on efficiency. Low intake losses, pipe with high coefficient values, ex-

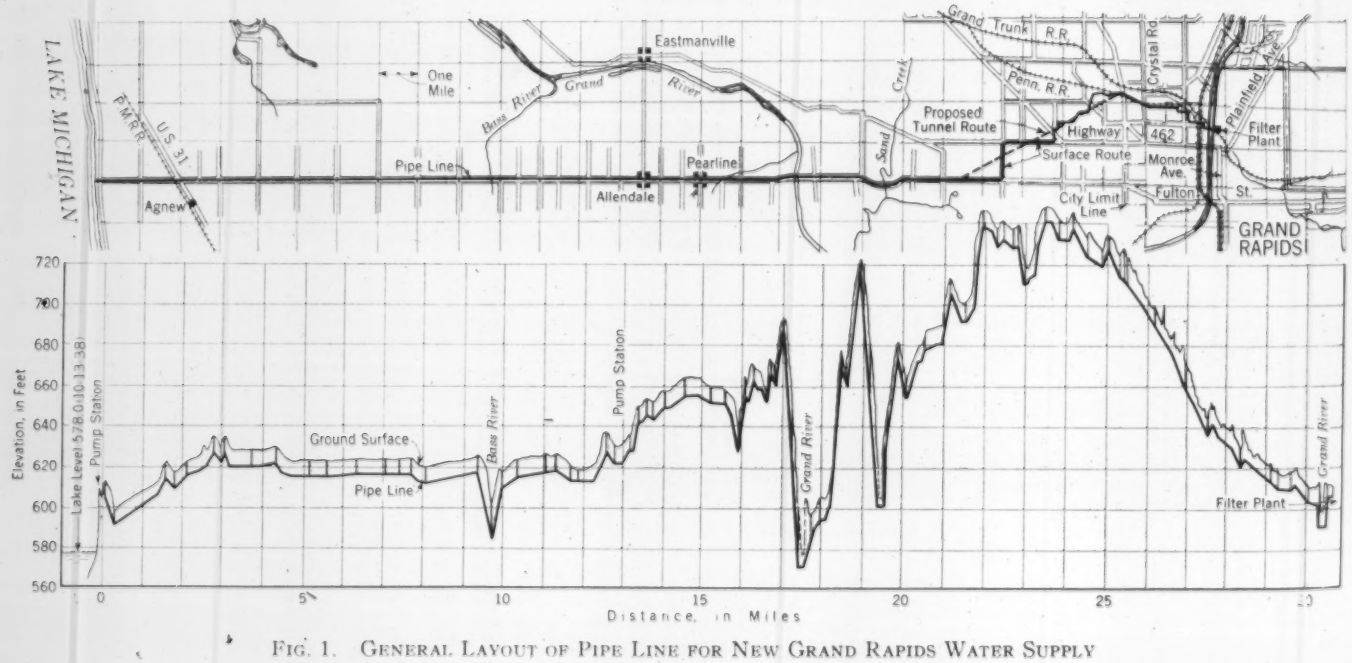


FIG. 1. GENERAL LAYOUT OF PIPE LINE FOR NEW GRAND RAPIDS WATER SUPPLY

tremely efficient pumps, and pumping stations designed for very low frictional losses, are all features contributing to this aim—namely, that of keeping operating costs at a minimum.

To offset increased fixed charges and higher pumping costs, there will be a substantial saving in cost of softening chemicals at the filtration plant. It is also anticipated that there will be an immediate increase in water sales due to the acquisition of new customers among the suburban towns and townships adjacent to Grand Rapids and among industries that do not now use Grand River water.

Since both wooden and steel intake cribs offered a satisfactory solution for the crib materials, alternate designs were prepared, the contractor having the option of using whichever material he preferred. The crib is in a 55-ft depth of water. Alternate designs were also made for the 6,000-ft intake line, with pipe materials of steel and cast iron. The contract was awarded on the basis of a wooden intake with a steel intake line 54 in. in diameter and $^9/_{16}$ in. thick, bitumastic coated and lined.

GENERAL CONSTRUCTION VIEW, SHOWING PIPE PLACING AND WELL-POINT INSTALLATION

In view of the experience of several other cities with lake supplies, it was felt most important that a marine joint be provided for the intake line which would not permit the entrance of lake sand. Several of these cities have been troubled with clogged intake lines and rapid wear on pumps as a result of such sand infiltration. A thorough search of the literature on the subject revealed that, in spite of the trouble experienced, very little had been done toward developing a satisfactory joint.

CARRYING THE PIPE LINE UNDER A RAILROAD

The 46-In. I.D. Concrete Pipe, with Joints Completed, Is Jacked Through a 72-In. Corrugated Metal Pipe. The Intervening Space Is Left Unfilled

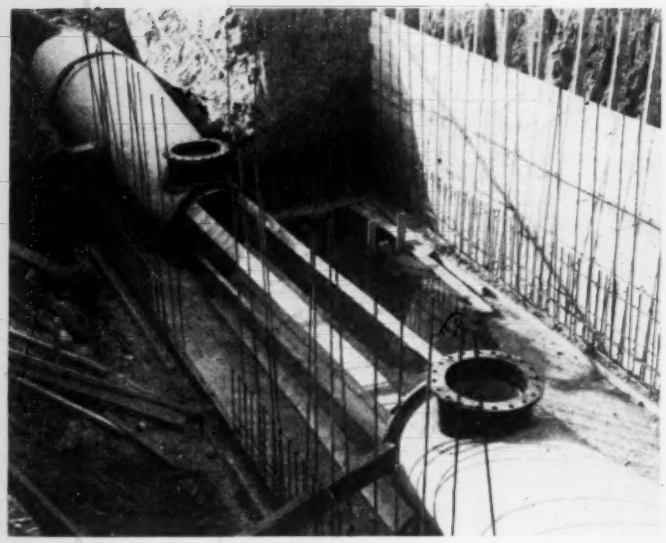
Accordingly, a series of experiments was undertaken in conjunction with the National Tube Company to develop a joint suitable for lake intake lines under Grand Rapids conditions. The requirements for the joint were that it should be watertight and sandproof, and that it should provide for expansion and contraction, successfully withstand severe storm conditions in the lake, and leave the water suitable for handling with high-lift centrifugal pumps of high efficiency.

An accompanying photograph shows the joint as finally developed. It consists of a Dresser coupling, with the addition of a "harness" and four 2-in. steel harness bolts. The coupling is assembled with stainless steel bolts. Harness bolts (S.A.E. 1035 steel) and harness are separated with lead washers $^5/_8$ in. thick. The joint withstood a test pressure of 300 lb per sq in., which, it is felt, justifies the belief that the joint is adequate to hold the couplings in place under the most severe storm conditions. Each joint is individually tested as it is laid in place, with a pressure of 70 lb per sq in. In assembling the joint the initial width between pipe ends is carefully adjusted so as to have a minimum free space of $^1/_2$ in. after the 70-lb test has been applied. As the temperature of the water drops below 55 F, this space is increased. The Dresser coupling will safely permit a total opening of $2^1/_2$ in., and the washers may compress as much as $1^1/_4$ in. under compression due to contraction in the pipe line. After each section of pipe is laid and the joint tested, an inspector examines it to see that all bolts are tight and that it has successfully withstood the test, and that the space between pipe ends is correct.

TUNNEL VS. OPEN-CUT LAYOUT

The final layout for the main pipe line, as determined after analyzing the advantages and disadvantages of several alternate locations, is shown in Fig. 1. Bids were taken on two systems. One provided for open-cut construction all the way, while the other provided for open-cut construction through the low ground, with 25,000 ft of 48-in. tunnel through the high ground. The tunnel effected a saving of 60 ft in elevation head, with a consequent annual power saving of $12,000 at the outset. However, the only bid received for the tunnel contract was so far beyond the economical limit of cost that the open-cut construction was adopted for the entire distance. Readvertising might have produced more and lower tunnel bids, but there was not time available for another letting. The urgency of speed in construction also favored work in open cut.

A great many combinations of pipe diameter and reservoir capacity, as well as surface pipe sizes in combination with tunnel sizes, were analyzed in order to arrive at the most economical pipe size and reservoir capacity with respect to total annual cost. In the end it was determined that large storage facilities must be provided in Grand Rapids if the size of the supply line were to be kept within the limits of reasonable cost. A large amount of city storage was also required for adequate fire protection in case of a breakdown in the line. The final design incorporated 40 million gal of reservoir



REDUCING SECTIONS, WITH MANHOLES, LEADING INTO A VALVE CHAMBER WHERE A 24-IN. CONE VALVE WILL BE INSTALLED

floating on the low-pressure system and a 3-million-gal reservoir floating on the high-pressure system, with provisions for pumping from the low-pressure reservoirs into the high-pressure system. For emergency conditions the present intake works at the Grand River in Grand Rapids will be kept in good operating condition.

EVALUATING THE PIPE LINE BIDS

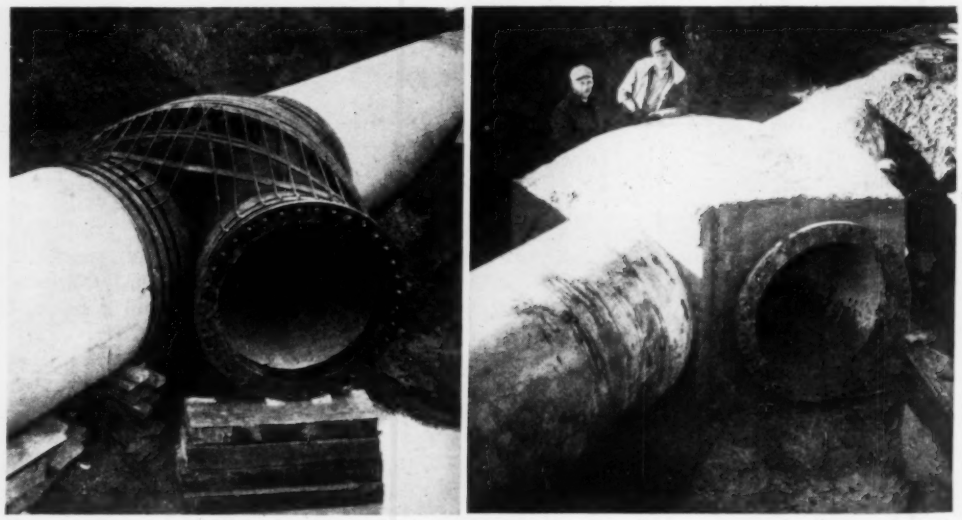
For the main pipe line, bids were received for four sizes and combinations of sizes, with an evaluation clause which stated how much additional money would be paid to secure the tunnel as against the surface line, and how much additional would be paid to secure the larger pipe as against the smaller. The sizes in the order of their preference were (1) 46-in.-diameter open-cut line in connection with a 48-in.-diameter tunnel; (2) 42-in.-diameter open-cut line in connection with a 48-in.-diameter tunnel; (3) 46-in.-diameter, all open-cut line; and (4) 42-in.-diameter, all open-cut line.

Bids were taken for various types of pipe on an equal basis—that is, there was no evaluation clause by which more would be paid for any one type because of a longer anticipated life. With the approval of T. H. Wiggin, M. Am. Soc. C.E., consultant on the project, an evaluation clause had been worked out by which different valuations would have been given to different materials. However, this evaluation could not be sustained by mathematical analyses without questionable assumptions, as required by PWA regulations, so its use had to be foregone. Straight competitive bids were taken on the following types of pipe: (1) cast-iron pipe, cement lined; (2) concrete pipe, reinforced with a steel cylinder and a steel cage of reinforcing bars; (3) steel pipe, bitumastic coated and cement lined at the mill; and (4) steel pipe, bitumastic coated in the factory and cement lined in place in the field.

After all evaluations and comparisons were completed, the contract was awarded on the basis of an all-surface, 46-in. diameter, concrete pipe, for an average cost of about $11.50 per ft in place exclusive of river crossings. The pipe is reinforced with a steel shell and a cage of steel reinforcing bars. It may be noted that a hydrostatic test on the first section of about 3,000 ft of pipe laid showed a leakage of only 14 gal per inch diameter per mile per 24 hours.

One of the two high-head pumping stations included in the project is located at the lake shore and the other 13 miles east of the lake. The lake-shore station will have five vertical-shaft centrifugal pumps, ranging in individual capacity from 14 to 31 mgd and combining to pump 55 mgd against heads ranging from 220 to 325 ft. The 13-mile booster pumping station will have four horizontal-shaft centrifugal pumps with individual capacities from 14 to 31 mgd and combining to pump 55 mgd against heads ranging from 200 to 250 ft. Pumps were selected for both stations so that maximum capacity could be maintained even with the largest individual unit at each station out of operation. These nine pumps will have guaranteed over-all efficiencies from 83.8 to 86.6%, which, it is believed, will make them one of the most efficient groups of high-head pumps ever installed for similar conditions.

At the present time the entire project is under contract, with every prospect of completion on schedule by May 25, 1940. The project is being carried out under the direction of Peter A. Kammeraad, Director of Public Service in Grand Rapids, and a special water committee consisting of City Commissioners Harry Leonard, James Quinlan, and John McNabb. Engineering and supervision are by Consoer, Townsend and Quinlan. T. H. Wiggin and F. M. Dawson, Members Am. Soc. C.E., were engaged as special consultants. Resident engineers for Consoer, Townsend and Quinlan are Joseph A. Schudt and Keller Wallace, with C. Lester Nelson as inspecting engineer on the intake. Milo F. Ohr, M. Am. Soc. C.E., is project engineer for the Federal Works Agency.



DETAIL OF THE 46-BY-42-IN. FLANGED Y-CONNECTION TO BOOSTER PUMPING SECTION, BEFORE AND AFTER CONCRETING

An All-Welded Elliptical Cage of Straps and Bars Comprises the Reinforcement at This Point. Visible Beneath the Cage Is the Thin Steel Membrane of the Concrete Pipe. Design Head in This Section of the Line Is 350 Ft

Effect of Foundation on Earthquake Motion

An Examination of Some of the Basic Problems of Applied Seismology

By R. R. MARTEL, M. AM. SOC. C.E.

PROFESSOR OF STRUCTURAL ENGINEERING, CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA, CALIF.

SOME day, says Professor Martel, engineers may turn to the specialist in soil mechanics, rather than to the seismologist, for data and advice on the transmission of earthquake forces from ground to structure. Certainly there is a closer relation between soil mechanics and the study of earthquakes than may at first appear. With this in mind, Professor Martel reviews important points in the present knowledge of earthquake behavior, particularly as regards the relation between the foundation material and the motion pattern of the quake. Much of the confusion surrounding such problems, he says, "has resulted from the uncritical acceptance of reiterated opinion as fact, and from the dearth of quantitative measurements," and in concluding he stresses the increasing need for an organization directing its activities entirely "to the solution of the problems of earthquake damage and its mitigation." The article is abridged from a paper before the Soil Mechanics and Foundations Division at the 1939 Annual Convention.

AT first glance, earthquakes and soil mechanics may appear to be only remotely related. It would also seem that questions relative to the proper assumptions of ground motion to be used in the design of earthquake-resistant structures should be referred to the seismologist and the geologist. But geophysical researches have given little or no information as to the exact motion of the ground in the meizoseismic area—that is, in the region where destruction occurs—and while the engineer is interested in the broad and general dicta of the seismologist, he is much more concerned, for design purposes, with precise information regarding the site on which he is to erect a structure. Moreover, it is obvious not only that earthquake motion is transmitted to a structure through its foundation, but also that the motion of the foundation material for some distance down and around the structure is in turn affected by the motion of the structure. A certain portion or "bulb" of the foundation may be considered to act as a coupling between the structure and the larger geological area of the earth's crust. Hence just as the engineer of an important structure now turns to foundation specialists for data and advice regarding the transmission of static vertical loads from his structure to the ground, he may, in the future, do likewise regarding the transmission of dynamic lateral and vertical forces from the ground to the structure.

It is pertinent then to examine the basic questions that may be raised and the information that is now available to help formulate the answers. Perhaps the two most important ones are: (1) Is the ground motion in the meizoseismic area utterly chaotic, or does it have a definite pattern or characteristic motion? (2) How does the pattern or characteristic motion in the meizoseismic area vary for different foundation materials? From the great number of more or less accurate published descriptions of damage done to buildings and other structures, a few general qualitative conclusions have been formulated.

Unquestionably the most common general conclusion is that soft soils of little cohesion are more dangerous than firm compact soils. Many specific instances can be adduced to support this widely accepted dictum. But a few exceptions may be cited. In the Tokyo earthquake of 1923, the damage to brick buildings was greater in the Hongo district, which is on diluvial soil, than in the downtown district, which is on soft alluvium. Somewhat similar results were obtained from a study of effects of the Long Beach earthquake of 1933. There the damage to brick buildings located on the softer, more recently deposited alluvium, with ground water at from 2 to 10 ft from the surface, was less than to similar buildings on the older, more firmly consolidated marine terrace deposits with ground water not so close to the surface. Damage along the beach, below the bluff, was also less than on the higher ground.

It should be noted that in both these exceptions, a differentiation has been made between sedimentary soils of recent geologic age. There is at least one other exception, where foundation materials were more widely different. That is at Azravrete in 1899, where buildings situated on a small alluvial plain within a basin of shattered crystalline rock suffered less than those on the sloping rock sides of the valley.

As a quantitative measure of earthquake destructiveness, the maximum acceleration has been most commonly used. Since usually there were no instrumental records from which this could be determined, the steady accelerations required to cause the overturning or sliding of simple objects such as gravestones have been taken as an index of destructiveness. Examples of such calculated accelerations, from various sources, are given below:

EARTHQUAKES	DATE	ACCELERATION
Messina	1908	$0.20g$
San Francisco	1906	$0.20g$
Long Beach	1933	$0.35g$
Assam	1897	$>g$

The Assam calculation is based on the observation that rocks were projected from their ground sockets. In one instance a triangular stone 12 by 9 by 10 in. in cross section, 3 ft long and slightly imbedded in the ground, was thrown a distance of $6\frac{1}{2}$ ft.

Large structures are not damaged to the extent that would be anticipated from such high accelerations. This is perhaps due to the fact that the ground movement does not reach its maximum value simultaneously at all points of the base of a large structure, so that an averaging effect is produced.

Instrumental records of ground motion in the area of destruction are few, in part because of the limited number of installations and in part because many of the instruments are too sensitive to record strong motion. Most of the earlier records were made on long-period seismographs designed to give the displacement of the ground. With such an instrument short-period waves of small amplitudes appear as inconspicuous wiggles on the longer-period waves of large amplitude. It was from

such records that Inamura and Suyehiro computed the acceleration at Tokyo for the earthquake of 1923 as 0.11*g* to 0.15*g*, and Dewell plotted the periods of successive waves for the principal portion of one component of the 1923 shock. While it is theoretically possible to obtain velocities and accelerations from a seismogram by successive differentiation, the practice has been to assume that a wave is sinusoidal, and to compute the velocity and acceleration from the amplitude and period. Seismograms were doubtless the basis for the frequently repeated statement that the range of destructive periods is from 0.5 to 1.5 seconds.

During the past 15 years a number of short-period seismographs, called accelerometers, have been installed for the purpose of obtaining records of accelerations; many of the U.S. Coast and Geodetic Survey's instruments are of this type. Strictly, the distinction between long-period and short-period instruments is only relative; both will give displacement records when the period of motion is shorter, and acceleration records when the period of motion is longer, than that of the instrument. By successive integration of an acceleration record, velocities and displacements can be obtained, though here also it is easier to assume the motion as sinusoidal and compute velocities and displacements for a few waves.

For the Long Beach earthquake of 1933, the Coast and Geodetic Survey reported a maximum acceleration of 0.23*g* with a period of 0.3 sec. This seems more than sufficient to account for the amount of damage done. Coupled with many other field observations—such as those of tall chimneys which remained standing while shorter ones were overturned, and the fact that the greatest damage in some tall buildings occurred far above the base—this evidence indicates that a steady acceleration alone does not furnish a completely satisfactory explanation of the effect of earthquakes on structures. It raises the question: As a basis of design, is a steady acceleration the best practical approximation of the dynamic forces?

It is natural then to turn to studies of dynamics to see if a more satisfactory correlation between theory and observation can be found. Analytical and experimental engineering studies of many types of vibration problems have been made which give the response of elastic systems to disturbing forces or motions of known or assumed patterns. From either the displacement or acceleration record of the ground, it is possible to calculate the behavior of relatively simple structures subjected to this motion. Or models of such structures may be shaken by simulated motions and made to reproduce the behavior of the prototype. Some work along both these lines, using actual earthquake records, has been done. As yet the results of these studies cannot be applied with assurance to foretell the behavior of structures shaken by future earthquakes, since too few definite data are available to permit a reliable forecast of motion patterns of future quakes. However, it seems worth while to consider whether certain relations that have been found from dynamic analysis may be applicable to engineering structures shaken by earthquakes.

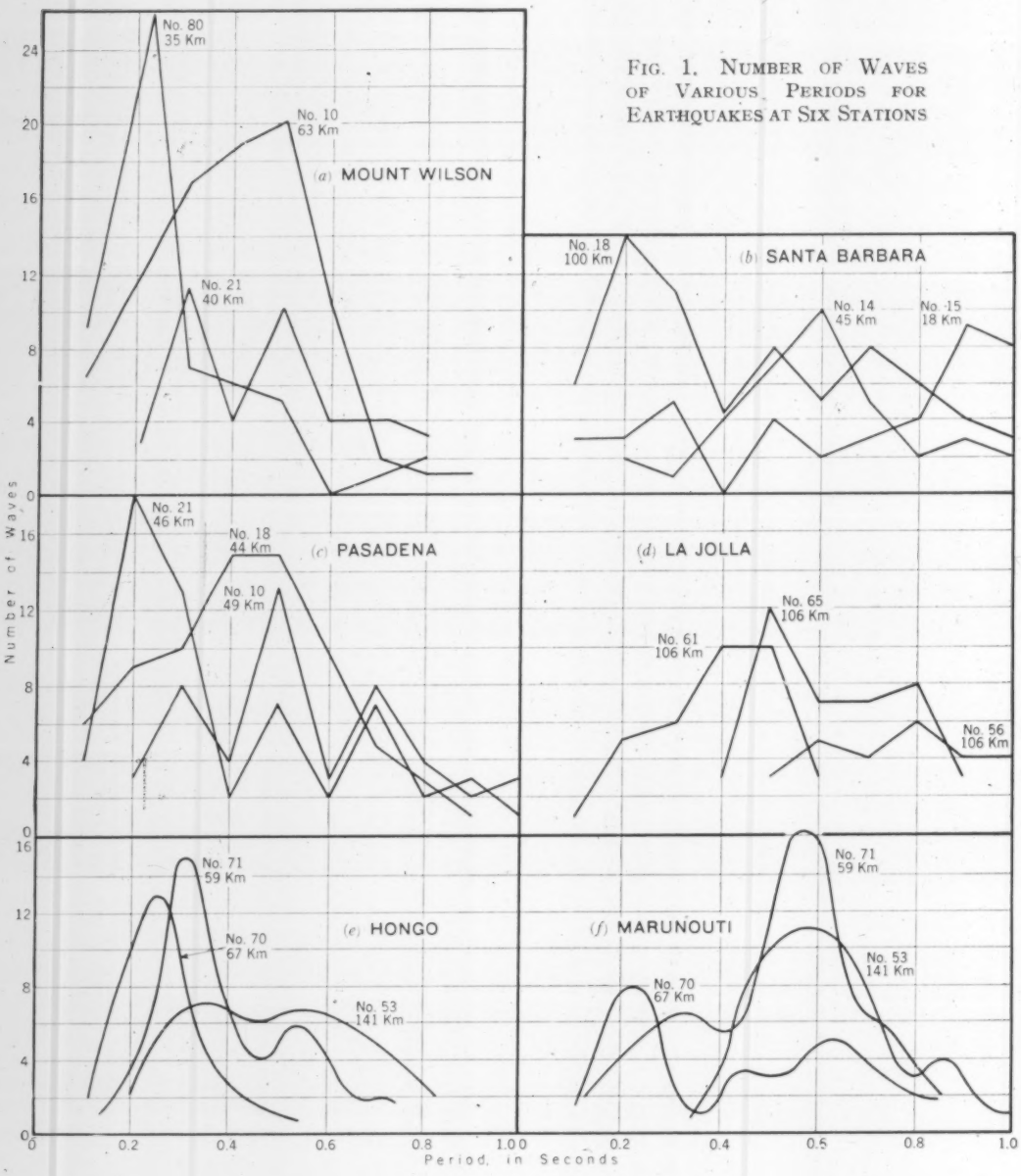


FIG. 1. NUMBER OF WAVES OF VARIOUS PERIODS FOR EARTHQUAKES AT SIX STATIONS

The most striking of these relations is the magnification of the motion of an elastic system when the motion to which it is subjected has the same period as that of the system. To produce a strong resonance effect, the structure must have little damping and both the structure and the disturbing motion must have the same or nearly the same period. However, it is not necessary to have the motion continue until a steady state is established, since the magnification from transients is rapid. Under resonance conditions, for a distant

earthquake, a maximum acceleration at the top of a building of about ten times that of the ground has been recorded. In considering the dynamics of structures subjected to earthquakes, definite data are required relative to the character of the ground motion and of the elastic and damping properties of the structure.

Much work has been done, especially in Japan, to find out whether in a given district there exists a definite period or pattern of periods—a keynote of the ground—which would predominate during an earthquake. Sezawa, in a mathematical study, showed the possibility of the existence of such a period in the surface layer excited by seismic waves. Using a seismic analyzer, a modification of the reed frequency-meter, Suyehiro reported a predominant period of 0.3 sec at Hongo and 0.7 to 0.9 sec at Marunouti.

Gutenberg has examined over 2,000 earthquake records obtained at seven stations in California and reported his findings in Special Publication No. 201 of the U.S. Coast and Geodetic Survey. From these data, Figs. 1 (*a*), 1 (*b*), 1 (*c*), and 1 (*d*) have been plotted. The first number on the curves identifies the earthquake and the second number gives the distance to the epicenter. The Mt. Wilson and Pasadena stations are on weathered granite; La Jolla and Santa Barbara are on consolidated detrital material and heavy alluvium, respectively.

Carrying out similar investigations, Ishimoto has read, tabulated, and plotted the periods of waves recorded by accelerometers at a number of stations for a number of minor earthquakes. These plots give the frequency of occurrence of waves of different periods, and show that:

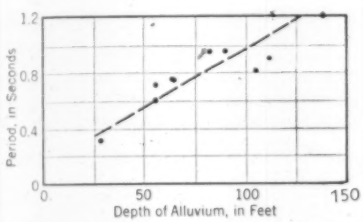


FIG. 2. VARIATION OF DOMINANT PERIOD WITH DEPTH OF ALLUVIUM

1. For a single earthquake there are peaks or summits that are more prominent at stations on hard soil than at those on soft soil.

2. For a given station, the peaks for different shocks occur at the same or nearly the same period in the majority of cases. Enough exceptions prevail, for stations on soft soil especially, to make determination of the predominating period from a single record of doubtful value.

3. The shape of the curves for stations quite close together may differ greatly. In general, for hard soil the peaks are pronounced; for soft soil, the curves are rather flat, with inconspicuous peaks.

A few of these diagrams selected to show variability of pattern rather than uniformity are shown in Figs. 1 (*e*) and 1 (*f*). Hongo is on comparatively hard diluvial soil and Marunouti is on soft alluvium. These stations are about two miles apart.

From his many investigations, Ishimoto believes that there is a fairly well defined relation between the predominating period and the depth of the sedimentary layer. (See Fig. 2.) However, he has been unable to find any relation between the dominant periods found in earthquake records and those from artificial disturbances (like the demolition of a wall, the movement of trains, or the operation of a sawmill).

As illustrations of the selective character of damage from single earthquakes, and of the variation in selectivity between different earthquakes, the following may be cited. In long Beach, only a few of the ornamental cast-stone light standards were damaged by the earthquake of March 10, 1933, but 273 of them were cracked by the relatively mild shock of October 2, 1933. They were located north of 27th Street and east of American Avenue. This damage would support the belief that resonance occurred and that such resonance was confined to a restricted area which moved with greater violence during the milder of the two earthquakes, presumably because the frequency-period curves for the two earthquakes differed. At the 79th Street School in Los Angeles, the older of two buildings was damaged by the earthquake of March 10 to such an extent that it was vacated. The newer building, which was only slightly damaged, was then used to house all the classes. The shock of October 2 caused considerable damage to the newer building (which had its axis at right angles to the other) and little additional damage to the older one. All classes were then moved back to the older structure. It is apparent that the pattern of the period-distribution curves for the two earthquakes differed greatly, and this makes it difficult to assume a single predominant period for this site.

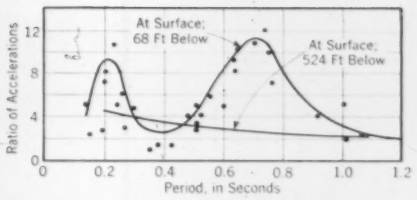


FIG. 3. RATIOS OF ACCELERATIONS AT THE SURFACE TO ACCELERATIONS BELOW THE SURFACE

Because in many instances it has been reported that earthquakes strongly felt at the surface were not noticed in tunnels, a number of studies of the variation in motion with depth have been made. Milne reported a ratio of amplitudes of 3.4 to 1 for motion at the ground surface and in a 10-ft pit. Suyehiro was unable to find such a wide difference, though he did find a 1.5 to 1 ratio for a period of 0.2 sec, and 1.3 to 1 for a period of 0.4 sec. From a careful comparison of records taken at the surface and in a tunnel 524 ft below, he reported a ratio of 3.5 for a period of 0.25 sec, decreasing rapidly to a ratio of about 1.25 for a period of 5 sec. (See Fig. 3.)

Recently, in downtown Tokyo, accelerometer records were taken simultaneously at the surface and at depths of 30 and 68 ft below ground, the latter being at the boundary of the alluvium and the harder diluvium. For eight shocks, the range of values of the maximum accelerations 68 ft below ground was about $^1/_3$ to $^1/_5$ of that at the surface. It is interesting to note, however, that for waves of the same periods, much greater differences in accelerations occur for periods of 0.2 and 0.7 sec—periods which are often predominant in the alluvial soil at Marunouti. (See Fig. 3.)

There is a fairly widespread belief that for a given earthquake the maximum acceleration will be higher on soft ground than on hard, and that the maximum amplitudes of motion will be greater on soft ground than on hard. For instance, reporting on the California earthquake of 1906, Wood gives the following table of accelerations:

Serpentine	250 mm per sec.^{2}
Sandstone	250–600 mm per sec.^{2}
Rock	250 mm per sec.^{2}
Sand	600–1,100 mm per sec.^{2}
Made land	1,100 mm per sec.^{2}
Marsh	3,000 mm per sec.^{2}

For the same earthquake, Omori arrived at the figure of 2,500 mm per sec.^{2} for the acceleration in made land.

Imamura states that a seismometric comparison shows that in Tokyo, alluvial soil is shaken fully three times

as severely as diluvial. This he attributed not only to the differences in amplitude but also to the difference in periods, which he believes are generally shorter in alluvial soil. More recent are the accelerometric comparisons of Ishimoto, which show a wide scattering of ratios between pairs of stations for different earthquakes. For example, of 12 earthquakes, 6 produced greater accelerations at Hongo (diluvial) than at Marunouti (alluvial), while in the other 6 the reverse was the case (Fig. 4). Generalizing from a greater number of his comparisons, there seems to be a trend towards greater accelerations on soft ground for earthquakes with distant epicenters, and greater accelerations on hard ground for earthquakes with close-in epicenters. The scatter, however, justifies the reservation that for a given earthquake the flip of a coin would furnish as satisfactory a guide as any in forecasting the relative accelerations on different materials.

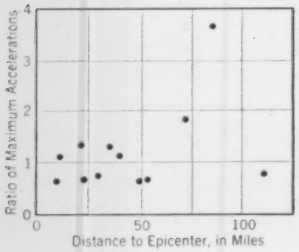


FIG. 4. RATIOS OF MAXIMUM ACCELERATIONS AT MARUNOUTI (ALLUVIAL SOIL) TO MAXIMUM ACCELERATIONS AT HONGO (DILUVIAL SOIL)

The difficulty of predicting, with any degree of precision, what will take place at one site close to and comparable with another for which data are available is shown in the following table, which gives the approximate relative values of maximum accelerations for nine earthquakes recorded simultaneously at three points within a radius of 1 mile:

SITE	CHARACTER	RATIO OF MAXIMUM ACCELERATIONS								
Nogeyama	Diluvial	4	3	3	3	3	2	2	2	1
Yokohama-Koen . . .	Alluvial	1	3	2	2	1	2	1	1	1
Takasima-Tyo	Alluvial	1	1	1	1	1	1	1	1	1

It will be noted that for one of the nine earthquakes the maximum acceleration on the diluvial soil was four times that on the alluvial soil, while for another it was the same. Other earthquakes gave intermediate values. Also note that for the two stations on alluvium the maximum acceleration at one varied from one to three times that at the other.

So far no attention has been given in this paper to the influence of the motion of a structure on the motion of the ground on which it rests. Suyehiro has attributed much of the motion of a rigid building on soft soil to rocking due to the yielding of the soil rather than of the building, and has reported some instrumental evidence in confirmation of this.

Both experimental and analytical studies of one of the U.S. Coast and Geodetic Survey records of the Long Beach earthquake indicated large resonator responses for many periods corresponding to those of the building in which the instrument was housed. This suggested that the record was materially affected by the motion of the building itself. For verification of this, tests were conducted by the Coast and Geodetic Survey in which the Hollywood Storage Building was caused to vibrate in its own natural period by means of a shaking machine. It is possible to observe when this resonant condition was reached on a record taken by an instrument set up about one mile away.

Two Japanese investigators have recently (1938) reported the results of somewhat analogous studies of accelerograph records for seven earthquakes from two instruments located within 300 ft of each other. One of these was in a wooden building at ground level and the other was in the basement, 12 ft below ground level, of the Earthquake Research Institute Building. The predominant period was generally 0.2 sec for records taken in the wooden building and 0.3 to 0.4 sec for those from the concrete building, and the maximum accelerations with one exception were 1.8 to 4.0 times as much in the wooden as in the concrete structure. This wide difference can hardly be attributed to variations in the basic ground motion in such a short distance, but is doubtless due to the combined effect of depth and of the buildings in which the instruments were housed.

Because of the stress that has been placed in this discussion on the complexities, the paradoxes, and the wide variability of the observational data involved in studies of earthquake behavior, it would seem at first that the answer to the question, "What are the bottom facts?" would be, "There are none."

MORE QUANTITATIVE MEASUREMENTS NEEDED

But much of the confusion surrounding this problem has resulted from the uncritical acceptance of reiterated opinion as fact, from generalizing on observations from too few earthquakes, from the dearth of quantitative measurements, and from the neglect of factors of importance. Nevertheless, it is possible to formulate certain statements of trends which can be made more specific in the future as the quantitative measurements of earthquake motions and the contributory factors increase, and as experimental and theoretical studies resolve apparently inconsistent data:

1. Accelerations computed from the overturn of small objects do not appear to be consistent with the damage to larger structures.
2. On hard soil there appears to be a characteristic pattern of period-frequency curves for minor earthquakes with peak frequencies for single earthquakes occurring within a band of periods. (It is not known whether the pattern for strong quakes would be similar.)
3. On soft soil, there appears to be a characteristic pattern of period-frequency curves for minor quakes with no sharply marked peak frequencies; no clear-cut differentiation can be made over a wide band of periods.
4. For nearby mild shocks, it cannot be said that the maximum acceleration on soft soil is consistently greater than on hard soil.
5. The fact that destructiveness has usually been greater on soft soil than on hard is probably due to characteristic period-frequency distribution and to the longer duration of the shaking.
6. The fact that a certain class of buildings on hard soil has occasionally suffered more damage than similar buildings on soft soil would appear to be due to the presence of a marked peak in the frequency-period curves.
7. Short-period waves seem to become attenuated with depth, while longer-period waves are only slightly reduced in intensity.

In this paper it has been necessary to draw heavily on the work done in Japan. Earthquake studies there were begun in 1880, and since 1925 have been carried out by the Earthquake Research Institute. This Institute has a large full-time personnel, and other members drawn from allied fields participate in its activities. While some excellent work is being done in the United States in pure and applied seismology, it is increasingly evident that there is need for an organization here to direct its activities entirely towards the solution of the problems of earthquake damage and its mitigation.

Roadside Control Through Zoning

Problems of Restricting Property Along Highway Rights-of-Way Discussed with Special Reference to Experience in California

By L. Deming Tilton

Consultant, California State Planning Board, Sacramento, Calif.

"THERE are reasons," says Mr. Tilton, "why zoning even after twenty-five years of application in cities, is not more extensively used to protect highway improvements." He proceeds to detail the more important of the difficulties that stand in the way of effective roadside zoning, and to show what steps should be taken to overcome them. The first and the most important step in any district or state is the preparation of a comprehensive, long-term, master highway plan. Without this, he states, zoning can never be made an effective tool to supplement engineering and construction in any program of highway improvement.

THE modern highway, especially in urban areas, is generally the old carriage road made over, and is much less efficient than the machines which use it. In one district it may encourage such intensive business and industrial development that it loses value as a transport facility; in another locality it induces property blight and decay and destroys values over a wide area.

The common defects of a major highway on the outskirts of a city are almost too well known to need review. Its right-of-way is narrow; intersections are frequent, and speed-limit zones and stop signals numerous; frontage is devoted largely to highly competitive small businesses which use the highway in every possible manner for private purposes; residential uses of abutting property are steadily decreasing; and open agricultural frontage is changing in character, providing sites for a mixture of outdoor advertising, roadside stands, wrecking yards, night clubs, and beer parlors. Moreover, subdivisions are springing up, miles outside cities, with numerous cross streets and intersections and with prospects of more parking on the highway, more driveways, more stop signs, and more speed limit zones.

The prohibitive cost of constructing enough wide parkways and other special types of highways to relieve such conditions has led to the study of the possibilities of zoning as a supplementary means of relief. In critical areas, the modernization of the highway system can only be accomplished by the blasting away of encroachments or by the opening of wholly new traffic channels, whatever the cost may be. But available funds will permit only a few such projects to be undertaken each year. In the meantime, the processes that make these spectacular replanning jobs necessary continue all over the land. What can be said of zoning as a means of arresting the spread of those marginal diseases of highways which adversely affect the circulatory system of the nation?

Zoning Procedure in California

California probably leads in the zoning of highway frontage, and this experience deserves a brief review from the standpoint first of procedure, then of application to highways. In California, zoning may be done by either cities or counties. There are no intermediate agencies, called towns in the East. The basic authority for zoning in both cities and counties is derived from the constitution of the state, which gives to each city and county the right to "make and enforce within its limits all such local, police, sanitary, and other regulations as are not in conflict with general laws." The Planning Act of the state of California establishes the procedure by which cities and counties carry on planning work and make and adopt police power ordinances. This act expressly authorizes zoning in the section dealing with precised plans, stating that such plans may include "regulations limiting the uses of lands, the uses of buildings, the height and bulk of buildings, the open spaces about buildings, the location of buildings and other improvements with respect to existing or planned rights-of-way . . . including procedure for the administration of such regulations."

Wherever zoning is to be undertaken for the purpose of protecting highway investments, establishment of a planning commission by ordinance of the legislative body of the city or county is essential. The first act of the planning commission leading directly toward regulation of the uses of land is the preparation and adoption of a master plan covering the area under its jurisdiction and showing, among other things, an "inventory and classification of natural land types and of existing land cover and uses, and comprehensive plans for the most desirable utilization of land." The adoption of such a master land-use plan places both the planning commission and the legislative body in a position to adopt and make effective a zoning ordinance.

After the adoption of a master plan of land utilization, following one advertised public hearing, the planning commission proceeds with detailed analysis of the area to be zoned and the preparation of a zoning ordinance which can be passed ultimately by the City Council or the County Board of Supervisors. This ordinance can be made effective within any described territory, for the Act authorizes preparation and adoption of plans "for all or any part of the city, county, or region." This may be interpreted to mean areas bordering main or other highways.

This By-Pass Street in Ventura, Calif., Was Built Only a Few Years Ago Through Open Country

Already 25-Mile Speed-Limit Signs Are Posted

AN EXAMPLE OF GOOD ZONING
Riverside Drive, Los Angeles, Which Is Zoned Against Business Except for Certain Corners, One of Which Is Shown

Two advertised hearings are required on the zoning ordinance by the planning commission. When the commission is satisfied that the ordinance is in reasonably complete form and all the requirements of the law have been met, it transmits the draft of the ordinance and the report covering its investigations, findings, and conclusions to the legislative body. After one advertised public hearing, the legislative body may adopt the ordinance. Neither the public generally nor property owners vote upon a zoning ordinance.

Zoning in cities is comprehensive in the sense that the scheme of districts usually covers the entire corporate area. In counties, however, a zoning ordinance is generally applied only to those parts of the county in which control of private land uses can be justified.

The unincorporated areas of counties which have been zoned fall into three classes: (1) suburban neighborhoods on the outskirts of cities, (2) small unincorporated communities, and (3) lands bordering main highways. The property owners in suburban areas, when fully informed, recognize the protective value of zoning and give support to community plans and land-use regulations. The detached towns of well-defined character also accept planning and zoning, but the nondescript roadside settlements are not so readily convinced that zoning will help them.

The zoning of margins of highways is undertaken in the belief that the state, which builds a through highway with funds contributed by highway users, has an interest in the highway "corridor" as well as the public right-of-way. The construction of the highway obviously makes possible a transformation of private property abutting upon and lying within a certain zone subject to highway influences. If the changes in use of property due to the presence of the highway can be shown to affect the public investment in the highway, private property can be regulated in the public interest. The legal theory behind the zoning of a highway corridor is fundamentally sound, but owners of property along the margins of highways loudly deny its validity.

City and county zoning ordinances have three primary values or uses: (1) In certain sections they have made setback lines effective and prevented encroachment upon highway rights-of-way. (2) They have been used mainly, however, to segregate property uses, and particularly to restrict business and industrial uses to certain areas. (3) In some cities and counties, zoning along highways has an esthetic purpose and is applied, in part at least, to control the types of buildings erected and the location and character of outdoor advertising devices.

The application of zoning in both cities and counties in California is not general, and cannot be considered to reveal a consuming local interest in highway problems. Of the 55 counties in the state, only 17 have zoning ordinances in effect. Of the 282 incorporated cities, only 115 are zoned. And as far as highway protection is concerned, many of those cities that are zoned could not be much worse off if no such ordinances were in force.

When the present regulations of both cities and counties are examined closely, with special reference to their effectiveness in conserving highway values, they are found to be heavily overbalanced on the side of business development. The facts, as far as they can be ascertained, are as follows: (1) Both cities and counties, in spite of the best efforts of planning commissions, have found it difficult to classify highway frontage for uses other than business and industry. (2) The extent of the frontage so zoned invites development of conditions which lessen the ability of the highway to perform the functions for which it was created. The reports of highway authorities are replete with examples of the disastrous effects of both unrestricted development of highway frontage and excessive zoning for business upon highway investments. Frank Balfour, supervising right-of-way officer of the Division of highways, Los Angeles, refers to a certain exhibit in his district as follows: "This artery [Garvey Avenue] was constructed within the last five years by the Division of Highways . . . at an expense to the vehicle operators of the state of over $2,500,000. Today we find this highway almost solidly built up with cheap and inferior types of merchantile establishments from downtown Los Angeles to the city limts of West Covina, a distance of approximately 17 miles. Over 80% of this distance has automatically become a 25-mile zone, depreciating by about 75% the investment of motorists in this huge improvement which was constructed primarily for their benefit, or a cold loss of more than $1,750,000 to those who pay the bill."

SOME REASONS WHY ZONING IS NOT USED MORE EXTENSIVELY TO PROTECT HIGHWAY FRONTAGE

There are reasons why zoning, even after twenty-five years of application in cities, is not more extensively used to protect highway improvements. The mere listing of some of the more significant difficulties may point a way to their solution:

1. Limitations of personnel engaged in planning work, as regards both numbers and basic training.
2. Uncertainty of law in the application of zoning regulations in the sparsely settled rural sections of counties. Even after ten years there is still no definitive opinion from the higher courts of California clearly supporting the right of a county to regulate the uses of property along the borders of primary highways.
3. Resistance of local officials due to lack of understanding of zoning, a narrow concept of public responsibilities, and political subservience to local property owners.
4. Lack of enforcement personnel and machinery.
5. Objections of property owners, to whose appeals county officials are extremely sensitive.

6. Difficulty of classifying land in terms of proper ultimate use.

7. Instability of control, since a zoning ordinance is a legislative measure, subject at any time to amendment or repeal.

8. Lack of support of property owners along main highways.

9. Conflict of purposes, due to difficulty of defining basic purposes of zoning measures extending into open country and applied primarily for the protection of highway values. (Yet the zoning of highway frontage, particularly as it relates to concentration of business establishments and protection of present and prospective right-of-ways, can be shown to have definite value from the standpoint of public safety. The purposes of public safety are not sufficiently emphasized as distinguished from those of esthetics, and ordinances primarily valuable because of their relationship to public safety do not have the official support and general public acceptance which they deserve on this count alone.)

RESULT OF UNRESTRICTED ROADSIDE DEVELOPMENT

Promiscuous Commercial Uses Disfigure Ventura Boulevard, near Hollywood, Calif.

There is evidence that some of the factors which contribute to the fundamental deficiency and instability of zoning as a tool for use in highway planning can never be removed. There is evidence on the other hand, however, that the processes of zoning can be improved and its application extended and made a great deal more effective. These advances will be more notable as highway authorities identify themselves more directly with cooperative community and regional planning enterprises.

HOW CAN EFFECTIVENESS OF ZONING BE INCREASED?

Some of the reasons why zoning is not more widely used or more effective have just been reviewed. Consideration will now be given to the problem of removing these limitations. The control of private property may be extended by several means, a few of which are described:

1. Require, through state law as in California, the preparation of a comprehensive master plan for every urban or metropolitan region and for every county, such plan to show the type, permanent location, and ultimate width of right-of-way of every route having primary value as a public transport facility.

This is the first and most essential step toward development of a truly functional highway system properly coordinated with schools, business centers, flood channels, railroads, parks, and other elements of the regional pattern. As the law stands in California, every local planning commission is under a mandate "to make and adopt a comprehensive long-term general plan" for the physical development of the area under its jurisdiction and this plan is to be the "master plan."

Adoption of a master plan is not zoning. The master plan has no direct effect upon the uses of private property. No objections from property owners, therefore, should stand in the way of preparation and adoption of a master plan. An important step toward accomplishment of many of the objectives discussed here will be taken if every local planning agency can be provided with funds and urged to do the first and foremost job for which it was created—to make and adopt a master plan.

Experience in California shows that there is a significant popular interest in the master plan idea, a fact confirmed by the adoption of the New York City charter, which requires budgeting of capital expenditures with reference to the master plan. It is supported also by recent recommendations of the Bureau of Public Roads setting forth the broad objectives of a nation-wide highway improvement program and giving clearance to state and local highway authorities for preparation of long-term master plans. The preparation of these plans will lead inevitably to wider and more realistic study of the effectiveness and costs of freeways, elevated and depressed routes, parkways, and similar specialized types of traffic ways, and protection of the public investments in all types of highways by zoning. Zoning has never had comprehensive analysis from such a standpoint.

2. Require (by state law) each county and city to prepare and submit to the State Planning Board, within a reasonable period, (*a*) a map showing existing uses of land bordering all state highways as shown upon its master highway plan and within 500 ft thereof, and (*b*) a plan for the classification of such lands and the establishment of a desirable scheme of districts within which the various present and prospective uses of land may be concentrated and regulated.

Under this requirement, it will be noted, there is no compulsion that a zoning ordinance or land-use regulations be adopted. The act of recording the facts and of giving consideration to the problem of roadside control may in itself lead to further action for protection of highway values. In any event, the State Planning Board will have information at its disposal which it can transmit to highway authorities and use in the determination of state policies. The state cannot bring into existence a broad plan of zoning along all its highways, however, unless counties and cities can be compelled by some means to adopt zoning ordinances.

3. Give to the state highway agency or the State Planning Board authority to require zoning of highway margins according to certain minimum standards, as a condition precedent to the approval of highway construction projects or allocation of highway funds.

It is doubtful whether the state has authority by legislative action directly to compel cities and counties to adopt zoning regulations governing uses of property bordering state highways. The plan suggested is an indirect approach to this authority. It requires transfer of a measure of control over zoning from local government to the state itself. There are various ways by which this might be accomplished through the amendment of present zoning laws.

AN IMPORTANT THROUGH-TRAFFIC ARTERY BUILT THROUGH UNDEVELOPED LANDS IN THE SAN FERNANDO VALLEY, CALIF.
Because It Was Not Zoned Against Business, Traffic Speeds Are Now Restricted and Congestion Is Increasing

The advantage of this plan is that it recognizes and accepts unchanged the present authority of cities and counties to make and enforce zoning regulations. It seeks merely to force action where there is inaction due to local inertia, indifference to state problems, or political cowardice.

4. By state legislation designate all highway frontage, and a corridor of reasonable width, outside incorporated cities as agricultural or scenic or both, unless zoned otherwise by local authorities, and prohibit the development or improvement of such frontage for other purposes except upon a showing of convenience or necessity and in accordance with a setback and building plan acceptable to state highway authorities.

A broad declaration of the purpose of the state to establish more effective control over uses of private land affecting its own transport system would in itself focus interest upon the general problem. The classification of frontage by the state would undoubtedly lead to adoption of local zoning measures. The county could establish commercial and industrial districts, but the withdrawal of such areas from the general agricultural or scenic district formed by the state should be subject to approval by the central highway authority or a state planning board. The purpose of marginal control is to preserve basic highway values; the state itself is best qualified to determine where and how these values are to be protected.

5. Change zoning procedure to give to the state itself power to zone private property abutting upon state highways and lying within the highway corridor. The grant of such power might be made conditional, that is, operative only when the state, by withholding highway funds or other means, finds itself unable to secure satisfactory planning and zoning on the part of local government. There are various ways by which this could be accomplished, among which is the establishment of a State Highway Zoning Commission, with power to investigate and report upon problems of roadside development and to develop and execute a state-wide plan for the control of uses of private property within a clearly defined highway corridor wherever such control can be legally justified in the interest of public safety or protection o. investments in state highways.

The difficulties in any plan which puts the state into the field of zoning should be obvious. Many questions immediately arise. Can the legislature delegate to a commission power to make and enforce a police power ordinance, or does the legislature itself, like a city council, alone hold power to establish districts and land-use regulations? The trend of court decisions today provides ground for the belief that a delegation of authority in this field might be upheld. Since enforcement of a zoning plan requires issuance of permits, how can the state provide the necessary services for checking applications, inspecting structures, making adjustments, and so forth? It is apparent that there would have to be correlation of highway zoning and similar efforts of counties and cities, and adjustment of the present rights which cities and counties have to regulate uses of property within their respective areas.

Assuming more extensive and effective local zoning activity and the utmost cooperation between all governmental units in the application of such measures to highway frontage, there would still be many serious highway problems. Those which arise from inadequacies of right-of-way can be solved only by more extensive land purchases. California, for example, has authority to acquire all land required for highway purposes and reasonably necessary for preservation of historic and recreation sites. It may also acquire scenic easements and lately has been given authority to acquire rights-of-way for freeways. There is little that now prevents the state from purchasing protection for its highways and scenic resources.

The prospect of any large-scale improvement in highways in urban regions is dimmed, however, by estimates of land cost. The scale of prices for property, even subsidized slum property, has been expanded to the point where the most essential types of highway improvements planned with adequate rights-of-way cannot be considered economically justifiable. The latest proposal is that the federal government undertake the purchase of these rights-of-way, employing a principle of excess-purchase which will allow subsequent exploitation of new values to contribute toward reduction of the first cost. But it is doubtful whether the federal government, powerful as it is and liberal as it may be in the use of its funds, can ever buy land in such quantities as to provide all the right-of-way needed for modern highways.

There is no substitute for an adequate right-of-way. Means must be found to enable the state to assert the prior claim of the public to land needed for essential public purposes. The highway system of the nation is vital and the people have a right to expect that their government will open and protect the wide channels required for the flow of their own community life-blood. Zoning is one of the measures that can be used to supplement and enhance the effectiveness of a land-purchase program.

The highways of tomorrow will not be built with money alone. The law will be called upon, as it has been in the past, to make a large contribution to highway progress. The principles represented in zoning have, to date, had little notice from highway engineers and little application as part of the highway development program. Yet zoning, if based upon a broad, far-reaching master plan, offers legal means of achieving at minimum cost many of the objectives now considered important in modern highway engineering.

Experimental Surface-Course Mixtures of Fine Aggregate and Cutback Asphalt

Arkansas Highway Tests Yield Data on Desirable Proportions of Solvent, Asphalt, and Filler

By L. W. HALL, ASSOC. M. AM. SOC. C.E.

RESIDENT ENGINEER, ARKANSAS HIGHWAY DEPARTMENT, STUTTGART, ARK.

FIELD experiments with a number of different mixtures of fine aggregate and cutback asphalt, used as a wearing course on a 6-in. compacted gravel base, are described in this article. The test sections comprise a 5-mile stretch of Arkansas State Route No. 1, between the towns of Wynne and Vanndale. Mixtures varied as to percentages of asphalt, solvent, and filler used, and as to temperature of placing, and the tests were sufficient to permit of fairly definite conclusions as regards the most satisfactory proportions for the materials used.

Materials were mixed at a stationary plant and trucked to the project, a maximum haul of 12 miles. The plant was an assembled one composed of a 27-E concrete mixer, a sand dryer, and a bucket conveyor which loaded batching bins from the dryer. Mineral aggregate and asphalt were weighed, the weight of the liquid asphalt being compensated for varying amounts of solvent in different cars. A uniform mix required one minute after all materials were in the drum, and the plant produced 20 tons per hour with reasonable regularity.

The surface-course mixture was dumped on boards on the grade, spread by hand at the rate of 200 lb of mineral aggregate per square yard (giving a thickness of approximately 2 in.), and raked. It was placed on half the road width at a time, so as to maintain traffic. A wood form was used along the center line only. Traffic was allowed on the wearing course immediately after rolling.

Two sands of somewhat different gradings were available, which for convenience will be designated as Nos. 1 and 2. Both were spherical. Their average gradings were as follows:

	Sand No. 1	Sand No. 2
Retained on the No. 4 sieve	3.5%	0.9%
Retained on the No. 10 sieve	15.8%	7.4%
Retained on the No. 40 sieve	68.0%	58.0%
Retained on the No. 80 sieve	96.6%	93.8%
Retained on the No. 200 sieve	99.4%	97.1%

The various mixes used are described in Table I. Quantities of asphalt as there given are exclusive of solvent in the cutback materials and are percentages by weight of the total mix. Quantities of filler are the percentages of the total mineral aggregate by weight passing the 200-mesh sieve. In mixes using sand No. 1, this material is limestone dust added to the sand. About 3% of the material in sand No. 2 passes the 200-mesh sieve. When higher percentages of filler are shown for mixes using sand No. 2, limestone dust has been added. Mixes Nos. 1, 2, and 3 were placed during the latter part of the 1937 season, and the remainder in the spring of 1938.

Mix No. 1 was first tried with cutback asphalt of the type RC-2, having 20% solvent. The sand was dried but all materials were mixed cold. The mix was spread on the road and raked but not rolled until the solvent content had decreased to approximately 7%, as indicated by tests on samples taken from the road. This was a slow process requiring from five to seven days. A crust about 1/4 in. thick formed on the material during the first day of exposure, which made further aeration below this depth difficult. A test on a core taken the full depth of the surface course indicated the presence of 7% solvent, but this was an average, and the percentage was no doubt considerably less near the top, and considerably more next to the base. This resulted in a condition simulating a soft base. The material cracked somewhat when rolled, although not extensively. After traffic had used the road two or three months it "alligator-cracked" over the entire surface, and the following summer bleeding and shoving occurred.

In an effort to reduce the interval between placing and rolling (required to lower the solvent content), we next tried heating the asphalt in a storage tank until the percentage of solvent was reduced to 12 (condition 1-A in Table I). During mixing, placing, and the 24-hour interval before rolling, the solvent was further reduced to 6 or 7%. This section did not crack when rolled; neither was the cracking so general under traffic, nor were the bleeding and shoving so acute. This would indicate that at least some advantage was gained by having a more uniformly distributed solvent content.

Mix No. 2 was placed in the same manner as mix No. 1-A, with about the same results except for slightly more bleeding.

During the summer of 1938 these sections, totaling 2,600 lin ft, were stabilized and cured by opening up, aerating, and respreading with a motor patrol, and rolling. Tests made just before these operations indicate that material next to the base had from 6 to 9% solvent.

For the next section the solvent was further reduced to 5% by heating, and mix No. 1 again used (condition 1-B in the table). This material could be rolled immediately after placing but it was difficult to obtain a satisfactory mix as the fluidity of the cutback asphalt had been materially reduced. There was an additional reduction of solvent of 2 or 3% during mixing and placing. This section remained in good condition, being stable and free from cracks and bleeding.

Mix No. 3 was next tried, and in order to facilitate mixing with the reduced solvent content, the sand was heated to about 225 F. This section was rolled immediately after placing and remained in good condition.

MATERIALS HEATED TO REDUCE SOLVENT CONTENT

From experience with the first three mixes it seemed logical, when work was resumed in the spring of 1938, to change to a type of asphalt having sufficient solvent to mix easily in the plant available and yet not have any appreciable amount in the mix by the time it was raked on the road. Also it was desirable, if possible, to use a mix that would not require the addition of limestone dust to the mineral aggregate. Thus it was decided to try cutback asphalt of the type RC-4, this material having from 11 to 15% solvent, with sand No. 2. Mix No. 4 was tried, both sand and asphalt being heated, the sand to a temperature of about 275°. On contact with the hot sand during mixing the solvent was reduced to less than 0.5%. The material mixed readily in one minute and

raked easily but remained quite soft after rolling. Hardening of the surface progressed noticeably for about five days but there was little apparent change thereafter. After an interim of 20 months a hard crust of about 1/4 to 1/2-in. thickness has formed on the surface, but beneath this crust the material has much the same appearance as when placed. There is apparently little cohesion between the particles of the mineral aggregate, the material being friable. This section, however, has the stability necessary to carry automotive traffic, which has not changed the contour of the surface either by rutting or shoving even at atmospheric temperatures as high as are customary in this locality. Animal traffic marks the surface extensively, and loaded metal-tired wagons cause slight rutting temporarily. Both markings and ruts are eliminated in a few hours by self-propelled traffic. To determine whether a reduction in asphalt would give a more desirable mix, Nos. 5 and 6 were tried in succession, but with little noticeable difference in the results.

To determine whether a small amount of solvent in the mix was desirable, an RC-2 asphalt was again used having 23% solvent, with mix No. 6 (condition 6-A in the table), the lower mixing temperature leaving more solvent. The section was softer than others placed with mixes Nos. 4, 5, and 6 under conditions leaving about 0.5% solvent. Mix No. 7 was next tried, containing a blend of the two sands with 1.75% limestone dust added. The result was not materially different from that obtained using mixes Nos. 4, 5, and 6.

Mix No. 8, with 2.75% limestone dust added to the 3% of material passing the 200-mesh sieve existing in sand No. 2, gave a tougher mix resulting in a harder pavement. Mix No. 9 gave results similar to No. 8, but seemed somewhat more desirable owing to the grading of sand No. 1. Then, in order to determine whether the comparatively high temperatures being used were having a detrimental effect on the cutback asphalts usually employed only in cold mixes, this mix was tried under conditions indicated as 9-A in the table, the lower temperatures being responsible for the additional solvent. The result was a slightly softer pavement for two or three days, but after that the section appeared similar to previous sections of this mix with the higher temperatures. Mixing was difficult at the lower temperatures, more time in the drum being required for even a fairly good mix.

Mix No. 10, in which 5.5% limestone dust was added to sand No. 2, resulted in a satisfactory mix that was quite tough. Mix No. 11 appeared to have too low an asphalt content. It was of a brownish color and remained in a condition similar to the other mixes of higher asphalt content with about 5% solvent, being quite soft for several days after placing. It finally, however, reached a condition similar to mixes Nos. 4, 5, and 6.

"BEST" MIX HAS SERVED 20 MONTHS WITHOUT MAINTENANCE

Mix No. 12 is considered the best mix tried and was used on approximately half of the project. The results obtained were about the same as with mix No. 9, the mixes being similar. Variation in heat was tried as described for previous mixes with about the same comparative results. A temperature of the mix in the truck of about 250° was considered most desirable, as this allowed the plant to operate at its greatest efficiency, mixing the material quickly and thoroughly. Also, this temperature left less than 0.5% solvent in the mix, which experience proved desirable. The resulting pavement possesses sufficient stability, and is pliable enough to resist cracking. It is marked very slightly by animal traffic and has a pleasing appearance. After 20 months' service it appears to be an entirely satisfactory surfacing material. No maintenance of any kind has been necessary.

The merits of the mixes other than No. 12 may be summarized as follows:

Nos. 1 and 2 have more asphalt than is necessary, although the serious trouble experienced with them seems to have been caused by the presence of solvent in the material next to the base to the extent of from 6 to 9%, as these sections were cured by aeration.

No. 3 is satisfactory.

Nos. 4, 5, 6, and 7 are considered unsatisfactory. Although all sections with these mixes apparently will stand automotive traffic satisfactorily, the pavement is considered to have too narrow a margin of safety, because of a deficiency of material passing the 200-mesh sieve.

Nos. 8, 9, and 10 are satisfactory, although No. 10 is considered to have more material than is necessary passing the 200-mesh sieve, thus unnecessarily increasing the possibility of cracking in cold weather.

No. 11 is considered unsatisfactory because of a deficiency in asphalt and in filler material.

A few degrees change in temperature has a marked effect on all mixes used. Early in the morning and late in the evening and on cloudy days the pavement is much harder than in the middle of a clear hot day. Penetrations on the residues of the cutback asphalts varied from 70 to 100 without materially different results.

Only sufficient rolling to shape the material, without leaving too distinct roller marks, is recommended. Rolling in excess of this has a tendency to shove the material laterally and to cause "blisters"—that is, the shearing off of the surface to a depth of 1/4 to 1/2 in. in areas about 18 in. in diameter. Traffic seems a more desirable agent for securing compaction and "tightening" of the material. A 7-ton roller was used, and it is believed that a lighter roller would have obtained better results. A 12-ton roller was tried but was entirely too heavy, causing excessive shoving laterally.

The following conclusions are meant to apply only to materials similar to those used on this project, with especial reference to the sands and their particular gradings:

1. While it is necessary to have solvent present in the asphalt to obtain satisfactory mixing with plant arrangements similar to those used, it is desirable to have not more than 0.5% in the mix when placed. Solvent in the amount of 1 to 3% is temporarily detrimental as it retards hardening; solvent in excess of 5% is permanently detrimental.
2. An asphalt content of 5% is sufficient and less than 4% is insufficient.
3. Six per cent of material passing the 200-mesh sieve is sufficient to obtain the necessary stability, and this stability cannot be obtained with less than 5%.

TABLE I. EXPERIMENTAL MIXES

Mix No.	Sand No.	Asphalt, %	Filler, %	Solvent, %*	Temperature*
1	1	7.0	5.0	17	Cold
1-A				9	Cold
1-B				3	Cold
2	1	7.5	5.0	9	Cold
3	1	5.5	7.0	3	200
4	2	5.0	3.0	0.5	240–260
5	2	4.5	3.0	0.5	240–260
6	2	4.2	3.0	0.5	240–260
6-A				5–7	190–210
7	50% 1, 50% 2	4.2	3.25	0.5	240–260
8	2	4.2	5.75	0.5	240–260
9	1	5.0	5.5	0.5	240–260
9-A				1–3	130–140
10	2	5.0	8.5	0.5	240–260
11	2	3.75	3.0	0.5	240–260
12	1	5.0	6.0	0.5	240–260

* As loaded in trucks.

Building the World's Largest Floating Bridge

By CHARLES E. ANDREW

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

PRINCIPAL CONSULTING ENGINEER, WASHINGTON TOLL BRIDGE AUTHORITY, SEATTLE, WASH.

CONSTRUCTION of the Lake Washington Pontoon Bridge has presented a number of interesting and unusual problems. Among these are the method of pouring and launching the pontoons, the setting of the heavy anchors that hold the structure, the adjustment of cable lengths, and the provisions for rigidly connecting adjacent pontoons. This article is the second by Mr. Andrew on the Lake Washington Bridge; the first, concerned mainly with design, appeared in the December 1939 issue.

ON December 10, 1939, the 15th of the 25 pontoons of the Lake Washington Bridge was floated from the drydock and made ready for towing to the site. Twelve pontoons were already in position on the lake, and 42 of the 64 anchors had been placed, making the floating structure 52% complete. Considering the time necessary for constructing the graving docks and assembling equipment, the project is progressing very nearly on schedule and, with efficiency increasing on each succeeding unit, the structure should be completed by July 1, 1940, or soon thereafter, without difficulty.

As stated in the article in the December issue, the pontoons are essentially cellular flat-bottomed boats, 59 ft in over-all width and from 117 to 378 ft in length. The cells are rectangular, the transverse and longitudinal walls being spaced approximately 14 ft 6½ in. center to center. Outside walls and bottom slabs are 8 in. thick, and the inner walls 6 in. thick. Every second transverse wall is a watertight bulkhead. All cells are accessible through manholes in the side walls.

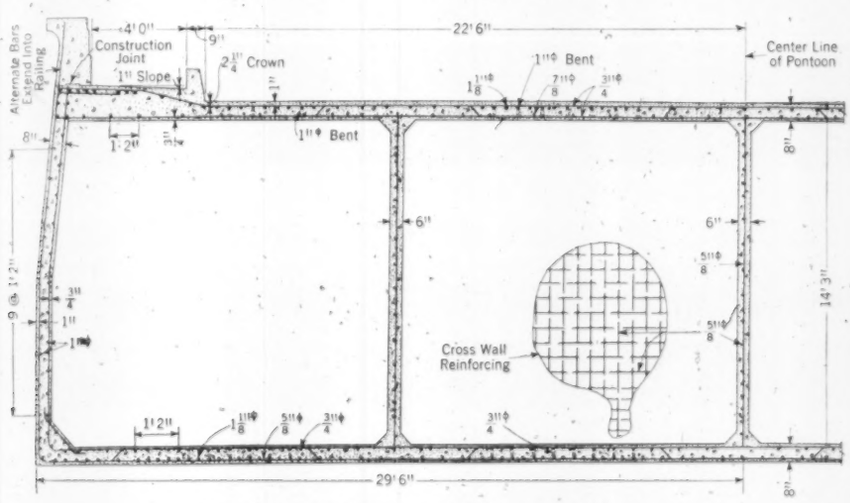


FIG. 1. HALF SECTION OF TYPICAL PONTOON

With Over-All Width of 59 Ft, the Pontoon Provides Four 11-Ft Traffic Lanes, a 1-Ft Center Strip, and Two 4-Ft Sidewalks

Ten of the 25 pontoons are duplicates, 14 ft 6 in. in depth and drawing approximately 7 ft of water. Other pontoons vary from 7 to as much as 14-ft draft, with varying multiples of 14 ft 6½ in. in plan dimensions. As much uniformity of cell dimension as possible is maintained throughout all pontoons to simplify form work.

SOLVING THE PROBLEM OF LAUNCHING PONTOONS

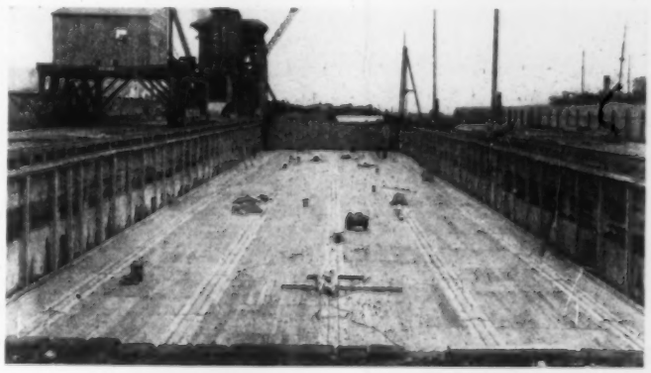
One major problem of the contractor was to devise the best method of launching the pontoons with a minimum of launching strain, and of pouring relatively thin, high walls of heavily reinforced concrete, watertight in character and without shrinkage cracks.

To solve the launching difficulties two graving docks were built on tide water. [For location, see Fig. 1 of article in December issue.] The local tidal range of from 10 to 17 ft afforded an ample means of launching. After casting, the pontoons are floated, the tide gates opened, and the individual units towed through the locks to Lake Washington.

The pouring of concrete in thin walls required a well-designed mix affording workability and at the same time avoiding segregation and shrinkage. Concrete of approximately 3,500-lb compressive strength in 27 days, with 5½ to 6-in. slump, using a liquid admixture, is used. Standard pontoons are poured in two successive continuous pours, the first including the bottom slab and inside and outside walls to the under side of the deck slab, and the second the top roadway slab. Figure 1 of this article is a typical pontoon cross-section.

The collapsible wood forms for the pontoons can be seen clearly in two of the accompanying illustrations. These forms are used alternately in one dock and then in the other, and pouring schedules are arranged to keep them as nearly as possible in continuous use. At the present time, between three and four pontoons are being completed per month with the exception of hand rails, which are poured after the pontoons are assembled at the bridge site.

Another major problem is that of setting the heavy concrete anchors required to hold the bridge. Three types are used, as shown in accompanying photographs and in Fig. 2. The A-type is employed at points where it is possible, by means of high-pressure jets, to sink the anchors into the clay of the lake bottom. There are 41



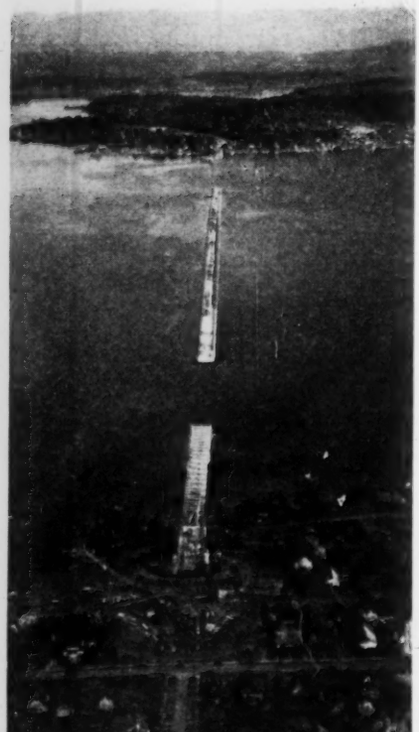
ONE OF THE TWO GRAVING DOCKS WHERE THE PONTOONS ARE POURED

POURING THE WALLS OF A PONTOON
The Pouring Carriage Moves on Rails Along the Dock Walls

of this type, each weighing approximately 65 tons in air. These anchors are cast on a barge and towed to the site, where they are lifted by means of a heavy derrick and lowered to within a foot or so of the bottom. After the location is checked by triangulation, and the alinement by diver on the bottom, high-pressure jets at the cutting edge are turned on and the anchor sinks until its top is well under the surface of the lake bottom.

FRICTION ANCHOR FOR HARD BOTTOM

Type B anchor is used in water over 70 to 80 ft in depth where the lake bottom is so hard that jetting cannot be accomplished. This is a friction anchor and consists of a concrete box which weighs approximately 75 tons when submerged. It is cast in the graving dock and floated and launched in the same manner as the pontoons. It is then towed to the site, where the same heavy derrick used on the Type A anchors is attached. Water is then let into the box and the derrick lowers it to the bottom. After the location and alinement are checked, the box is filled with sand and gravel through a tremie tube, and approximately 800 cu yd of quarry rock is placed in front of it for anchorage. Four B-type anchors are required.



PONTOONS IN POSITION, DECEMBER 1939
In the Foreground Can Be Seen the Twin Bore Tunnel Through Mount Baker Ridge

In both A-and B-type anchors the main anchor line is attached to the anchor before lowering, and after the anchors are placed it is stretched out on the bottom toward the pontoons, the inboard end being marked by a buoy. This end is picked up and socketed when the pontoon is in position. The proper length is determined by a light wire stretched from anchor to pontoon.

Type C anchors, of which there are to be 19, are used in water less than 70 ft in depth, where the bottom is too hard for jetting. They consist of two heavy steel piles in tandem, to be driven into the hard bottom (Fig 2) by means of a steel follower or under-water hammer. Anchor cables are measured and attached to the pontoons as in Types A and B.

Adjustment of cable-line length (either initial or as becomes necessary later) is accomplished by the device

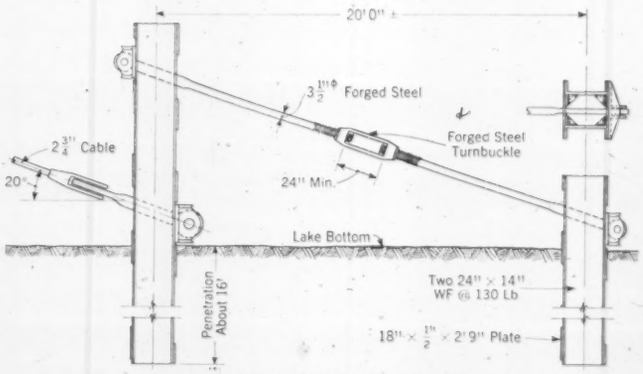


FIG. 2. TYPE C CABLE ANCHOR

shown in Fig. 3, using hydraulic jacks. The steps in this interesting operation are clearly indicated in that figure. Initial tension in the cables (in calm weather) is set at from 20,000 to 70,000 lb, varying directly as the cable length and lake level.

A third problem is that of rigidly connecting adjacent pontoons. The entire floating structure is about 6,561 ft long. This length is divided into four sections, each of

GENERAL VIEW OF GRAVING DOCK NO. 1

which is rigidly connected within itself. Beginning at the westerly end, the first section consists of four pontoons rigidly connected, with a total length of 948 ft 0 in. This section is provided with bilge pumps which pump water ballast either in or out to adjust the shore end to the 3-ft seasonal rise and fall of the lake. Between this and the next section, there is an articulated joint consisting of four spherical castings tied at their centers by large rods. This joint is designed to resist moment and shear in the horizontal direction and only shear in the vertical direction. In other words, it is a vertical hinge.

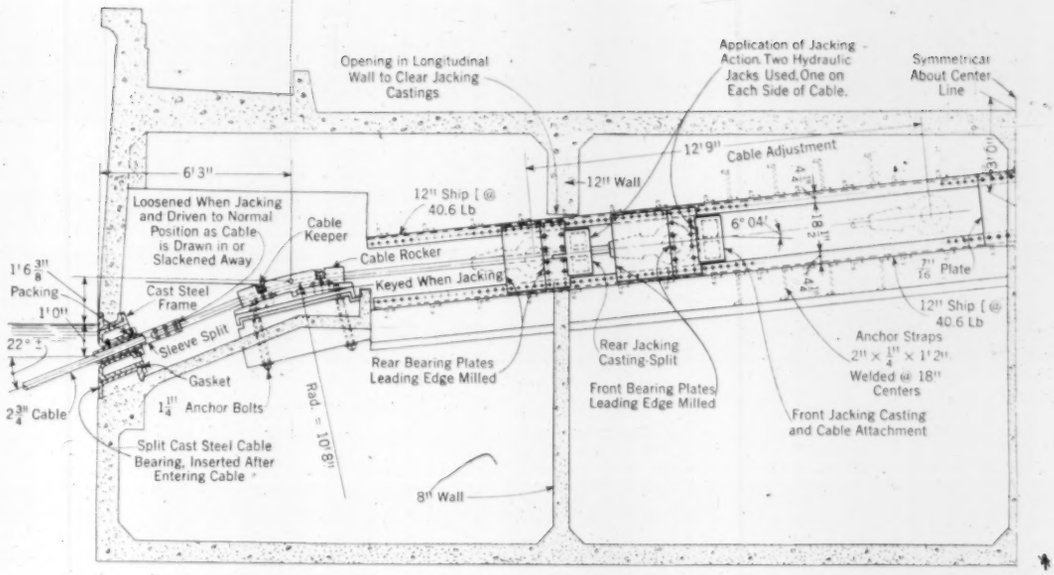
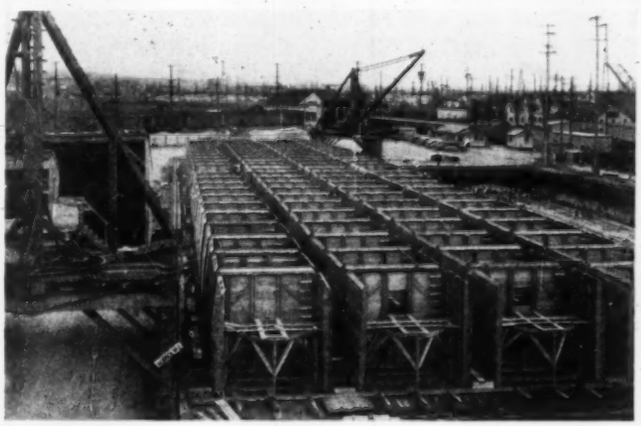

Opening in Longitudinal Wall to Clear Jacking Castings
Application of Jacking Action. Two Hydraulic Jacks Used, One on Each Side of Cable.
Symmetrical About Center Line
12'9" Cable Adjustment
6'3"
12" Wall
Loosened When Jacking and Driven to Normal Position as Cable is Drawn in or Slackened Away
Cable Keeper
12" Ship [@ 40.6 Lb
6'04"
Cable Rocker
Keyed When Jacking
1'6 3/8" Packing
1'0"
Cast Steel Frame
Sleeve Split
22°
Gasket
2 3/4" Cable
1 1/4" Anchor Bolts
Rad = 10'8"
Split Cast Steel Cable Bearing, Inserted After Entering Cable
Rear Bearing Plates Leading Edge Milled
Rear Jacking Casting-Split
Front Bearing Plates Leading Edge Milled
7/16" Plate
12" Ship [@ 40.6 Lb
Anchor Straps 2" × 1/4" × 1'2" Welded @ 18" Centers
Front Jacking Casting and Cable Attachment
8" Wall

FIG. 3. TYPICAL TRANSVERSE CABLE ANCHORAGE

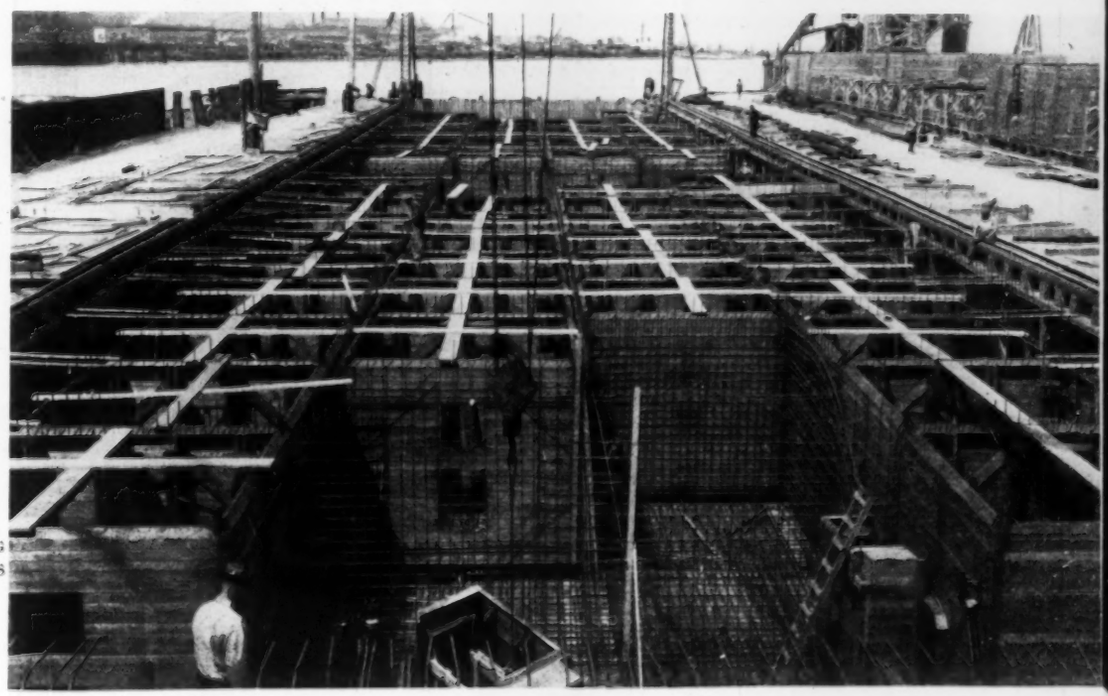
The second section consists of 14 pontoons with a total length of 4,522 ft rigidly connected. The third section consists of the movable pontoon connected to the second section by horizontal and vertical trunnions and to the fourth section (when closed) by locks resisting horizontal and vertical shear and horizontal moment. The moving pontoon is 378 ft in length but overlaps the second section 170 ft. The fourth section consists of 4 pontoons rigidly connected for a length of 947 ft 11½ in.



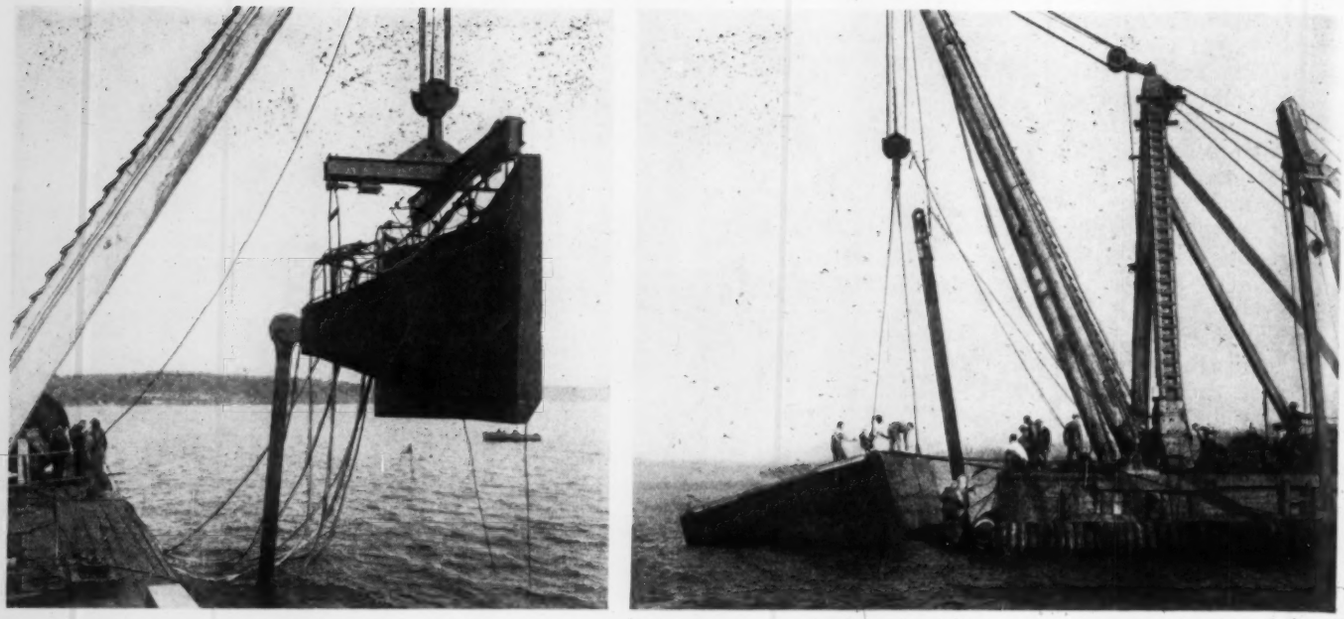
ASSEMBLING COLLAPSIBLE WOODEN FORMS FOR PONTOON CELLS

Rigid connections between pontoons (Fig. 4) are made by large rods around the top, sides and bottom, and all connections are designed to be slightly stronger in section than the pontoons themselves. A rubber gasket extends across the bottom and up the sides, placed throughout its length outside the connecting rods. Male and female shear keys are placed on abutting pontoons to aline them and later transmit shear. In making the connection, the pontoons are brought together entering the male shear key. Clearance for shims is provided and the shims are so placed as to bring the roadway surfaces and curbs in alinement. Rods are then entered in the top row of holes (above water) and the rubber gasket compressed until 1 in. of clearance remains between pontoon end faces. Ballast is then added to the other end of one of the pontoons until the gasket along the bottom (under water) is compressed sufficiently to waterproof the wetted perimeter of the joint. The plugs are then removed from rod holes under water, and the rods are entered and brought to sufficient tension to compress the gasket until 1 in. of space remains over the area of the abutting faces. In this position cement grout is poured into the opening, completely filling it to the roadway surface and completing the joint. Any shrinkage of this grout is then taken up by further tightening the rods.

The contract for the construction of the floating-bridge portion of the project is held by the Pontoon Bridge Builders, which is a company formed by the following contractors: Parker-Schram Company, Portland, Ore.; J. H. Pomeroy and Company, Inc., San Francisco, Calif.; the Puget Sound Bridge and Dredging Company, Seattle, Wash.; and Clyde W. Wood, Los Angeles, Calif.



PLACING REINFORCING STEEL AND CELL FORMS



ANCHOR PLACING: LEFT, TYPE A; RIGHT, TYPE B

In conclusion, it may be of interest to review briefly the history of the floating type of bridge. It is no doubt true that in prehistoric times some caveman, cleverer than the rest, tied several logs end to end across a stream too wide for one log, and by so doing built the first structure of this type. Following that achievement, and until only three or four hundred years before Christ, history only hazily records the development of the floating bridge. History does, however, record that in approximately the year 330 B.C. Alexander the Great was enabled, by the use of pontoon bridges, to greatly expedite his military movements. Many other old-world conquerors followed in his footsteps and made effective use of the pontoon bridge in moving their vast armies. Today military tactics require their use extensively. Of course, the military type of floating bridge has always been of temporary nature; its greatest value has often been due to the fact that it could be quickly removed when retreat became necessary.

One of the earliest permanent floating bridges used for highway traffic was constructed at Coblenz, over the Rhine, in 1819. It was first built of wood and later replaced by iron. Its length is 1,050 ft and it has a 21-ft roadway carrying the equivalent of our 15-ton truck loading. The general construction consists of pontoons perpendicular to the bridge center line anchored by chains to upstream anchors. The stream is subject to a rise of 28 ft.

OTHER MODERN BRIDGES OF THIS TYPE

The Ebrie Lagune Bridge connects the city of Abijon in French West Africa with Port Bonet on the Gulf of Guinea and carries a highway and a railway using a 39-ton locomotive. It is 1,200 ft long, with a 28-ft roadway, and is supported by steel pontoons 115 ft long, parallel to the roadway, on each side and connected end to end by hinges. The bridge is anchored upstream and downstream by 180-ft chains with adjustable winches which provide for a very considerable rise and fall of the water surface.

The *Engineering News* of April 30, 1908, carried an interesting description of "Pontoon or Floating Draw Bridges" built by the Chicago, Milwaukee, St. Paul and Pacific Railroad. Likewise the *Engineering News-Record* of August 5, 1920, describes a similar bridge across the Missouri River at Chamberlain, S.D.

The Golden Horn Bridge over the Golden Horn River at Constantinople is 1,530 ft long, with a 46-ft roadway, carrying metropolitan highway traffic. It was built in 1912 and is supported by 150-ft steel pontoons on each side of, and parallel to the bridge center line. One pontoon is hinged and movable to provide for navigation.

There is now being built in Tasmania a very interesting type of floating bridge across the river Derwent. It is designed as a two-hinged arch lying on the water convex upstream. The arch span is 3,400 ft. No anchors are used and forces from wind current and waves are transmitted either in compression or tension to abutments on each shore. The arch rib is a cellular concrete construction and provides a 30-ft roadway and one 6-ft sidewalk. The rise and fall of the water surface is approximately 6 ft and the structure will be subjected to drift, heavy winds, and wave action.

These few floating bridges, of the many heretofore constructed, are given as evidence that this type of bridge is not new but is, in fact, one of the oldest types of bridge known to man.

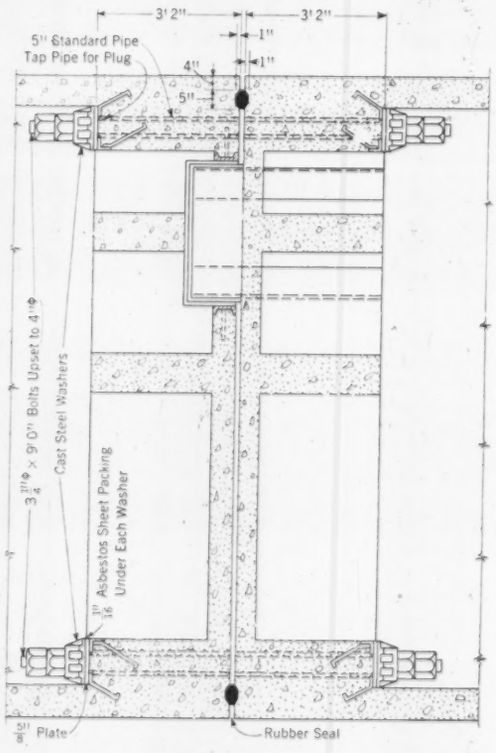


FIG. 4. DETAILS OF CONNECTION BETWEEN PONTOONS

Present Trends in Structural Design

A Review of the Phenomenal Developments of the Past Twenty-Five Years

By O. H. Ammann

Member American Society of Civil Engineers
Consulting Engineer, New York, N.Y.

STRUCTURAL design is a part of practically every branch of engineering. It has become extremely complex and embraces many highly specialized fields. In this brief review of recent developments and present trends in the United States, Mr. Ammann deals only with the fundamentals, with particular reference to bridges, buildings, and allied stationary structures commonly considered the field of the structural engineer.

In line with the almost revolutionary developments that have taken place in this country in the mechanization of industries and agricultural methods and in the forms and vehicles of transportation in the last twenty-five years, profound changes have also been witnessed in structural design. In fact the developments in this field have probably surpassed those made in any similar previous period, and the process continues unabated. These developments are based fundamentally on the vast expansion of our knowledge regarding the properties of materials and the behavior of structures under actual conditions. New methods of fabrication and construction have also had a marked influence on design—particularly the modern methods of producing efficient concrete and the application of welding to steel structures.

In recent years the public has been demanding that more consideration be given to the esthetic side of structural design. The recognition of this demand has led to a healthier collaboration between the engineer and the architect. This trend has been encouraged by the American Institute of Steel Construction, through its annual prize awards for beautiful steel bridges, and by efforts in the cement industry to produce better-looking surface concrete.

In the early years of this century the average structural designer in America did not concern himself with intricate stress calculations. In fact the complexity of the actual stress distribution in even the simplest structures was not generally recognized by him. He was content to analyze the so-called primary stresses, no matter how crude the assumptions upon which they were calculated.

Little attention was given to the true stress condition in connections, or to their effect upon the elastic behavior and safety of the structure. The character and magnitude of secondary stresses due to rigid joints, as well as the theories by which to ascertain them, were not generally known.

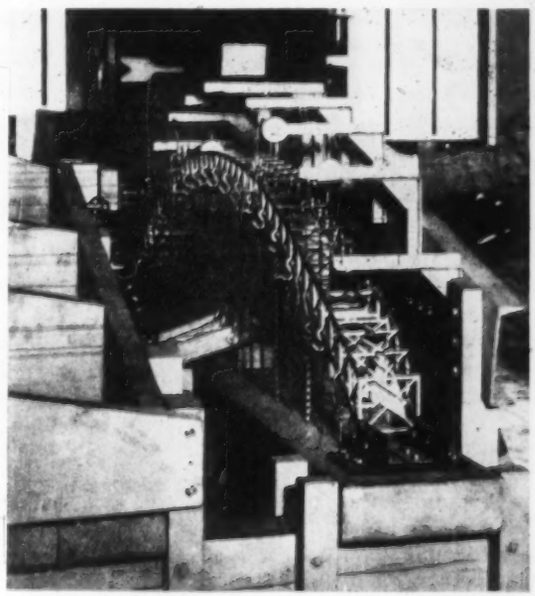
Important details, such as latticing of compression members, were proportioned by empirical rules rather than by scientific analysis. It was not until after the failure of the Quebec Bridge in 1908 that the importance of such details and their theoretical and experimental analysis was recognized, and their study energetically prosecuted.

Until comparatively recent years the structural-designer generally endeavored to confine himself to so-called statically determinate structures. His lack of familiarity with theories of elasticity and the elastic behavior of structures made him regard all statically indeterminate systems—even the simplest—with a certain suspicion.

In the last twenty-five years a wealth of refined knowledge has been built up in respect to the mechanics of structures. While most of the fundamental theories and refinements must be credited to European theorists, American engineers and scientists have produced numberless adaptations of this knowledge to practical problems of the most intricate character.

It is hardly possible to single out individual contributions, but mention should be made of the publication in May 1930 by Hardy Cross, M. Am. Soc. C.E., in the Society's Proceedings on the distribution of fixed-end moments, inasmuch as this work has undoubtedly stimulated the general use of indeterminate structures, both in steel and reinforced concrete.

The details and variations developed in the methods of analysis of continuous frames have been multitudinous. This is one of the most distinctive of recent trends in structural design. The prolific production of special methods of stress analysis, although it may sometimes give the designer the feeling of being hopelessly lost, is a healthy condition and will undoubtedly lead to further progress.



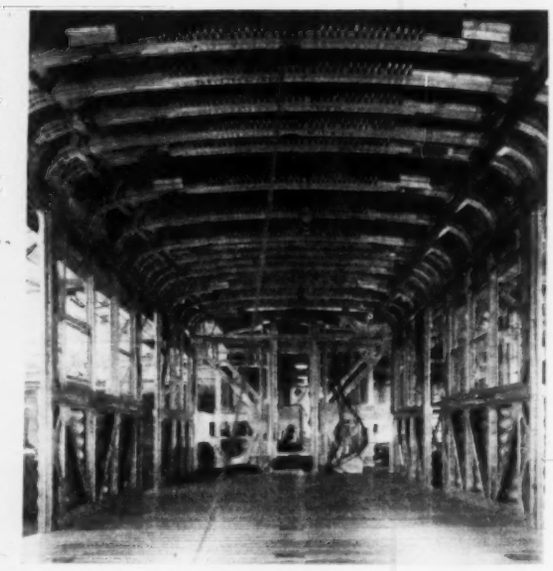
An Early Application of Model Study to Bridge Design

This 9-Ft Brass Model of the Bayonne Arch Was Used Largely to Test Effectiveness of Lateral and Sway Bracing Under Transverse Loading

Most structural engineers no longer distrust indeterminate structures; they recognize the advantages of continuity, notably in the design of rigid frames, continuous girders, and multiple-story buildings. The fact that many of our engineering colleges are making special efforts to teach their students the fundamental theories of the analysis of these structures shows that they realize such knowledge is a prerequisite for a successful designer. The concentration of thought upon the solution of stress problems in indeterminate stuctures has had the further effect of causing the designer to visualize structures in terms of elasticity and deformation. To the expert they are becoming more like living, moving things, whose actions

he understands and anticipates. He judges them by the work they are called upon to do in intensity as well as in time.

American engineers have had a leading part in the development in recent years of visual methods of stress analysis. Stress measurements by extensometer on models, on test specimens of structural members, and on a variety of actual structures, have become common. More recently photoelastic apparatus has been developed which gives both qualitative and quantitative data on two and even three dimensional stress distributions. This method has revealed stress conditions at certain critical points which had not been fully recognized. Reference is made in particular to the high stresses produced at points of abrupt change of section. As a result the designer has been cautioned to avoid such conditions. The method appears to offer possibilities in proportioning certain special structures with relatively short, thick members. It is quite possible, for instance, that this method might have served to reveal the severe and complex stress condition which must have existed in the cast-steel bearings which figured in the second Quebec Bridge disaster.



MANY ADVANCES IN STRUCTURAL DESIGN ARE INCORPORATED IN THE SPECIALIZED CONSTRUCTION OF THE LIGHT-WEIGHT, STREAMLINED TRAIN

TESTS ON MODELS AND LARGE SPECIMENS

The advancement of model tests is due largely to the persistent efforts of the late George E. Beggs, M. Am. Soc. C.E., at Princeton University. These efforts developed from modest plane models of celluloid or materials of similar elastic qualities, to elaborate metallic replicas of some of the most important structures or parts thereof.

Among the outstanding model analyses may be mentioned those made of various layouts for the suspension structure of the San Francisco Bay Bridge. These models were used as an aid in the selection of the type of structure and its governing proportions, as well as to check the calculated stresses and elastic deformations. Another earlier application of model study to bridge design was the use of a brass model of the 1,600-ft Bayonne arch span, on which an important series of tests was made principally to verify the effectiveness and intricate stress action of the lateral and sway bracing of the arch under transverse loading. Again, the stress distributions in the towers of the George Washington Bridge were checked by a plane celluloid model 6 ft high. These towers are trussed frames statically indeterminate to a very high degree. The model was tested in tension within the elastic deformations, and the measurements revealed remarkable agreement with the analytical results, which were later also verified by stress measurements on the actual structure.

Much more elaborate were the tests on a complete replica of the Golden Gate Bridge towers. This model was over 13 ft high and constructed of stainless steel welded in the shop. The test threw light on the complex stress combinations from vertical, longitudinal, and transverse forces and the secondary effect of the deformations of the tower frame, which is without any diagonal bracing above the floor.

Mention should also be made of tests on models of concrete arches. Such tests, made at the University of Illinois under the direction of Wilbur M. Wilson, M. Am. Soc. C.E., at Ohio State University under Clyde T. Morris, M. Am. Soc. C.E., and at Princeton under Professor Beggs, resulted in definite recommendations for the design of concrete arches by the Society's Special Committee on Concrete and Reinforced Concrete Arches.

Studies on models of tall-building bents under the action of transverse forces were made by Francis P. Witmer, M. Am. Soc. C.E., and Harry H. Bonner, at the Univerity of Pennsylvania.

These advances in theoretical analysis have been paralleled by numerous experimental tests of structural members and their connections. These included many series of column tests, notably the large-size tests which represented the heavy compression members of the Bayonne arch and of the towers of the George Washington Bridge. The test specimens, built of carbon, silicon, and manganese steel, had cross-sectional areas up to 159 sq in., and required the full capacity of the 10,000,000-lb testing machine at the U.S. Bureau of Standards. Such tests have not only furnished information on the elastic behavior and strength limitations of structural members, but have led to important revisions in design practice, notably in the proportioning of latticing and web plates of steel compression members.

Valuable information has been obtained from large-size tension tests of riveted connections, notably those made recently at the University of California by R. E. David, Glenn B. Woodruff, and H. E. Davis, all members Am. Soc. C.E. The question of fatigue in riveted joints has also recently been brought to the attention of the profession by tests made by Professor Wilson at the University of Illinois. It may be premature to draw definite conclusions as to what effect his somewhat startling results may have upon the design of riveted joints, but unquestionably they point to the possibility of a revision in our design practice.

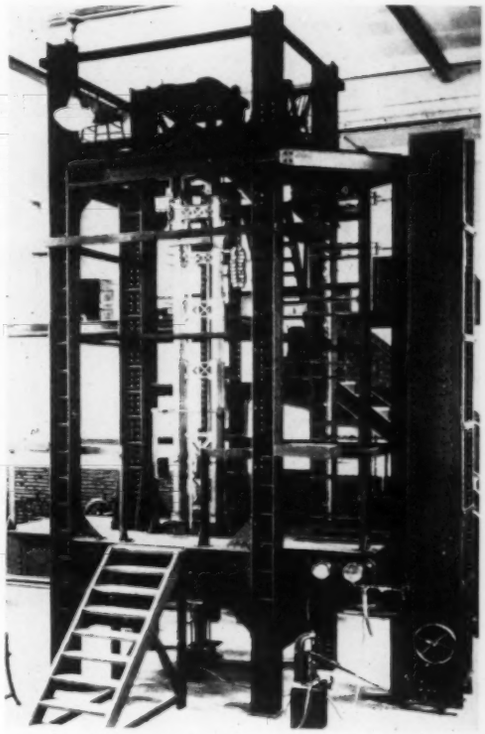
Tests on large-size specimens are no longer confined merely to the determination of elastic behavior and ultimate strength. Increasing use is being made of refined extensometer instruments to get a picture as nearly complete as possible of the actual distribution of stresses under different load conditions.

Extensive stress measurements made on actual structures have also added to our knowledge of their stress condition. The primary purpose of such measurements has been to determine the character and magnitude of secondary stresses in truss members and the stress distribution at critical points. Notable advances in stress measurements were made during the erection of the Hell Gate arch. More recently elaborate measurements were carried out on the George Washington Bridge and the Bayonne Bridge. Such measurements have in general verified the theoretical analysis as regards average primary stresses, but they have also revealed the very considerable variations of stress which actually exists over the cross-sections, and the shortcomings of the theory in

cases where its assumptions proved crude or uncertain.

Developments in design as influenced by improvements in materials are well illustrated by the case of steel. In the early years of this century there was available to structural engineers practically only one class of steel, broadly termed structural carbon steel, made by the open hearth process. There was conspicuous lack of uniformity however, even in this product, as various grades of soft, medium, and hard steel, ranging in ultimate strength from 58,000 to 76,000 lb per sq in., were being used.

Today the qualities of this class of steel have been improved and standardized, and this fact is in part responsible for the higher working stresses now generally permitted. Moreover, though structural carbon steel is still used in the vast majority of ordinary steel structures, the use of two or more types of steel in the same structure has become common practice, and it is one of the problems of the designer to make the most economical disposition of these materials in a structure.



ELABORATE TESTS ON STAINLESS STEEL MODELS OF THE GOLDEN GATE BRIDGE TOWERS THREW LIGHT ON MANY COMPLEX STRESS COMBINATIONS

The advent of the long-span bridge and the tall building brought about a demand for higher-strength alloy steels to save weight and dimensions. For some time nickel steel, with a strength 50 per cent higher than ordinary carbon steel, seemed to fill this demand and found application in such notable structures as the Queensborough and Manhattan bridges in New York, the Quebec Bridge and many others, first in the form of forged eyebars and later also in riveted members. Even nickel steel rivets were used in a few structures. During the World War a new alloy steel, known as silicon steel, with a strength about 40% higher than ordinary structural steel, entered the market and because of its materially lower cost has since greatly restricted the use of nickel steel. Today the cost of manufacture of silicon steel has been reduced to such an extent that it can compete with ordinary structural steel even in structures of moderate proportions.

In more recent years attempts have been made to introduce other high-strength alloy steels. Manganese steel having a strength comparable to that of nickel steel found its first important use in the main compression chords of the Bayonne arch. While high in compression strength, it does not appear to be well adapted for tension members. Copper-bearing steel has come into general use because of its greater resistance to corrosion. Studies are under way for the application of structural aluminum, and actual use has been made of this light metal in the partial reconstruction of bridges which might otherwise have become obsolete because traffic had become heavier than the loading for which they were designed. High-strength stainless steel is also a possibility for stationary structures such as bridges and buildings.

The need for light-weight alloys in other than bridge work, and chiefly in airplane and railroad-car construction, has tended to develop a series of new and more efficient sections, largely of the "closed-box" type. Advance in welding technique is closely allied with this light-weight construction. While improved, this technique still requires much study to reach the degree of certainty and perfection essential for the safety of structures.

Marked improvements in the manufacture of cement and advances in concrete making have materially contributed to progress in the design of concrete structures. Prior to the publication in 1918 of the cement-water ratio theory of Duff A. Abrams, M. Am. Soc. C.E., combinations of cement and aggregate were on an entirely empirical basis, and the attainment of a predetermined compressive strength was largely a matter of chance. More recently notable improvements have been made in the quality of the cement itself, which is the result of modified chemical composition and improved manufacturing processes, including finer grinding. Concrete made with cement of recent manufacture now attains compressive strengths approximately 50% greater than those of concrete made ten years ago.

There is a very definite trend toward the use of light-weight bridge floors as a means of effecting economies in the entire bridge structure. Many types of such floors are now available, including steel plate floors, usually with a surfacing material; floors of interlocked steel panels with fillers and a surfacing material; composite steel grid and concrete floors; open grating steel floors; light concrete slab construction; and aluminum alloy types. Of all these types, the open grid decking, of which various styles are now produced, has made the most outstanding progress in recent years. Whereas in 1932 only one important bridge had this type floor, at present at least 85 are equipped with it.

The importance of the development of high-powered fabricating machinery, equipment, and methods cannot be overlooked in the general picture of modern trends in design. Assembled members weighing as much as 150 tons can now be turned out by means of power-operated punches, drills, shears, planers, and riveters. Welding plays a more important part in the fabricating shop than in the field. Other advances include the use of tractor cranes; alloy steels in travelers to reduce weight; bolt-tightening machines; and electric, diesel, and gasoline-powered hoisting equipment.

In erection the trend is toward heavier and more efficient equipment. In many cases, as in the San Francisco Transbay Bridge and the Golden Gate Bridge towers, the design of the structure takes into account the type of equipment to be used in erection. On the towers referred to, hammerhead cranes, mounted inside the column section, were used.

Prefabrication of steel houses, although not particularly noteworthy as a trend in the East, has increased on the Pacific Coast and in the vicinity of Chicago.

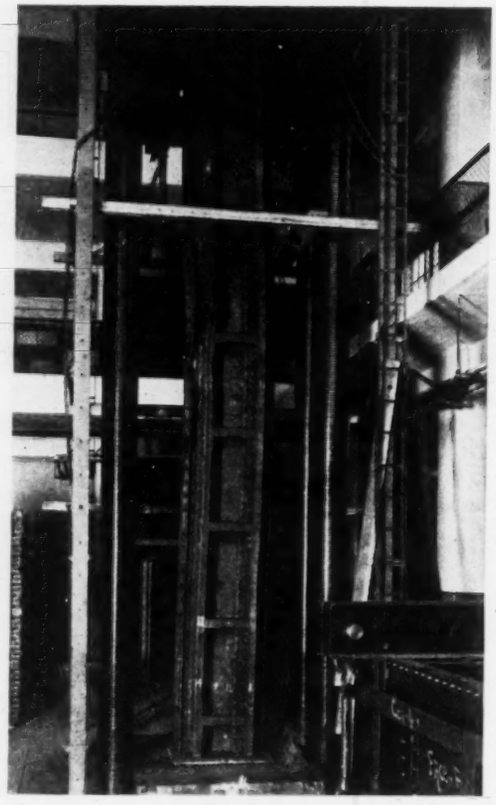
MORE FREEDOM IN DESIGN

The more thorough knowledge of the character and actual behavior of structures has led to greater confidence

and freedom on the part of the designer. He is encouraged to depart from conventional practice and to try uncommon forms and types. In this process he has been aided by the growing demand for consideration of esthetics in structural design, and he has found that this demand is not in conflict with a broad interpretation of the technical and economic requirements. The process has been slow but in the last twenty years has led to very material changes in the general form and details of our structures and to the development of some new types.

In the field of steel bridges, the change in structural forms and proportions has undoubtedly been influenced to a large extent by the advent of the modern highway bridge, the design of which calls for material departures from both the comparatively light road bridge of the past and the extremely heavy and rigid structure needed to serve modern railroad traffic.

Broadly speaking, we find a tendency toward greater structural simplicity and functional clarity through more compact distribution of the materials. In steel structures, narrow mesh trussing, bracing, and lattice work are being avoided more and more. Truss spans are designed with fewer members, which makes their appearance less clumsy than that of many of the older bridges, with their multitude of structural details. The present trend also is to avoid extraneous ornamentation.



A MODEL THAT TAXED THE CAPACITY OF A 10,000,000-LB TESTING MACHINE

Tests like This One on a Half-Size Model of a George Washington Bridge Tower Column Have Led to Important Revisions in Design Practice

ACCENT ON SIMPLICITY

Not many years ago the use of the solid plate girder as a structural element was confined to comparatively short, simple spans. Today the use of this very simple and esthetically satisfying form has been greatly extended, not only by its application to much longer spans with or without continuity over the supports, but by its adaptation to arch ribs, rigid frame bridges, viaduct bents, and stiffening girders of suspension bridges. The somewhat harsh lines of the parallel flanged girder for overhead crossings or continuous viaducts have been improved by the use of a curved bottom flange.

Greater structural compactness is also apparent in the individual members of trusses, columns, and so forth. In place of the former open latticed member we find increasing use of the solid H-shaped section, either rolled or riveted, or the closed box section. Diagonal sway bracing in truss bridges is more and more being replaced by simple rigid frames, or the intermediate bracing is eliminated altogether.

The so-called Vierendeel truss has so far not found favor for the main trusses of bridges in this country except in one or two cases. Important applications of the principle of this type of design are found, however, in the transverse bracing of the towers of the Waldo-Hancock suspension bridge in Maine and the Golden Gate Bridge in San Francisco. In the Bronx-Whitestone Bridge towers, the transverse bracing is reduced to the simplest type of two solid-web portal frames.

Radical changes have also taken place in the character of connections of steel trusses, and much more attention is being given to their effectiveness. The loose pin connections prevalent until twenty-five years ago have practically disappeared in modern design and made place for the more rigid riveted connections.

Welding has made relatively little advance in the United States as applied to connections in bridge structures, but it has been increasingly used in building construction. There has been a trend toward municipal approval of welding; in 1938 New York City and Chicago added it to their building codes. A number of medium-sized buildings with welded steel frames have since been erected in New York City. As engineers gain increasing experience with, and confidence in welding, it is bound to expand into broader fields.

The design of reinforced concrete structures has also made great progress. Engineers are realizing that in concrete construction continuity is inevitable, that it must be taken care of by suitable design, and that its advantages should be utilized. In modern bridge work, reinforced concrete is being used in the form of rigid frames and continuous girders, as well as arches. Not only are such structures made of solid sections, but hollow cellular members are coming into wide use.

The growing popularity of such designs for larger structures is illustrated by the construction in Nebraska, in 1936, of a rigid-frame span 109 ft long. In the state of Washington a continuous girder bridge has been built with a span of 190 ft, and another rigid-frame structure has a span of 175 ft.

Mention should be made of the material changes which have taken place in the last 25 years in the design of structures located in areas subject to earthquakes, notably the West Coast. The comparatively recent destructive earthquakes in California and Tokyo have furnished a wealth of knowledge on the effect of earthquakes on structures of various modern types and have led to the development of theories and rules to guide the design of structures to safely resist earthquakes.

As a result there have been very radical changes in the type and design of certain structures, principally buildings. In the design of important bridges, notably the Transbay and Golden Gate bridges in San Francisco, the effect of earthquakes was carefully investigated. While by reason of their flexibility these great suspension bridges are among the most effective earthquake-resisting structures, it was necessary to make certain provisions to render them safe against the most intensive earthquakes so far experienced.

In conclusion let it be pointed out that there is yet a wide field for improvement in structural design. The structures we are building today may appear to us as the culmination of efforts in this field of endeavor, but they will become commonplace or outranked by the creations of future generations.

Plywood and Laminated Timber Construction

Second of Two Articles on Modern Structural Applications of Timber

By IRA D. S. KELLY

ASSOCIATE MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CIVIL ENGINEER, TOPEKA, KANS.

IN the December issue Mr. Kelly reviewed the recent progress of timber research and standardization, and described a wide variety of important applications of timber-connector construction. In the present article he completes his highlights of modern structural uses of timber with a discussion of nailed and glued laminated construction, structural plywood construction, composite timber-concrete floor slabs and T-beams, and "Lamella" roof construction.

IN order to utilize smaller and less expensive sizes and species of timber, and to provide built-up sizes and shapes not possible from solid timber, laminated timber construction using nails or spikes, bolts, timber connectors, or glue, has been developed.

A common form of nailed laminated timber construction (Fig. 1) is used extensively in floors for bridges and industrial buildings. Little research is available on which to base design methods; however, a series of exploratory graduate research studies was completed several years ago at the University of Illinois; and more recently the West Coast Lumberman's Association has completed some research to determine the beneficial effect of distributor beams under such floors. Further research is needed on which a reasonably reliable formula for the effective width of distribution of concentrated wheel loads may be based. However present accumulated experience has led to working rules for distribution of concentrated loads and the nailing of laminations that results in nailed laminated timber floors giving long and satisfactory service. The light weight and low cost of such floors recommends them for extensive use.

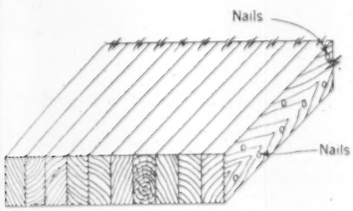


FIG. 1. LAMINATED NAILED TIMBER FLOOR

A further application of nailed laminated timber construction is represented by recent installations of composite timber-concrete bridge and dock floors. In this type of construction (Fig. 2) vertical laminae are assembled and nailed or spiked as for laminated timber floors, but with the top edges of alternate laminae higher than the others so as to form grooves approximately equal in depth to the width of the laminae. Into these grooves are driven thin triangular metal plates at a slight angle so as to penetrate the top of the low lamination and cut the top edges of the high laminations. These plates are spaced at varying intervals, much as stirrups are spaced in reinforced concrete beams, so as to provide resistance to horizontal shear between the timber and the concrete. Also into these grooves are driven crossed spikes at intervals so that their heads will be embedded in the concrete surfacing and provide adequate resistance to vertical separation. A layer of reinforcing steel is placed over this assembly, and additional tension reinforcement is provided over regions of negative bending moment in continuous slabs. Over this assembly is placed a surface of normal-strength concrete, care being taken to secure adequate spading or vibration of the concrete into the grooves and adequate curing. By this method concrete and timber are made to work together effectively providing a permanent, protective, and stress-carrying surface over the timber. This type of construction has been tested at the George Washington University in Washington, D.C., to determine proper design methods and the load-carrying ability of its component parts, and has been proved practical through many installations.

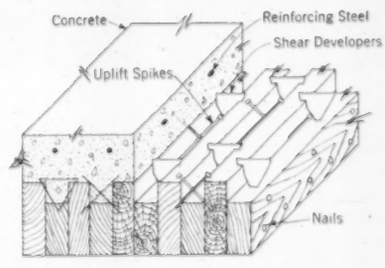


FIG. 2. COMPOSITE TIMBER-CONCRETE FLOOR

Even though not laminated timber construction, composite timber-concrete construction should be mentioned here. In this type (Fig. 3) the tops of solid timber stringers are dapped at intervals, and spikes are driven into the tops of the timbers. Over these stringers, and filling the daps, is placed a reinforced-concrete slab of conventional design. This assembly is considered to act as a T-beam, when the daps and spikes are designed to provide adequate resistance to horizontal shear, and when the differing elastic properties of the two materials are taken into account. This type of construction has been tested at the Oregon State College and proved practical through installations in the Northwest.

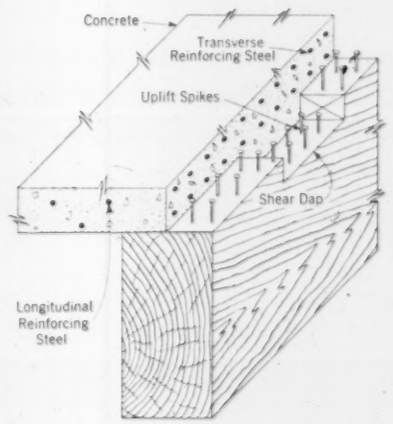
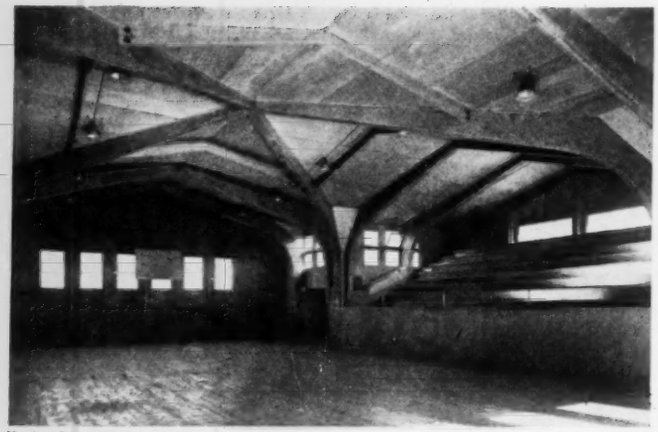


FIG. 3. COMPOSITE TIMBER-CONCRETE T-BEAM

Nailed laminated timber or composite timber-concrete bridge floors may be combined advantageously with timber-connector construction in secondary highway bridges. For simply supported spans of 12 to 24 ft in southern yellow pine, or 12 to 36 ft in Douglas fir, the floor may be supported directly on solid timber stringers, with a curb and handrail assembly using either split-ring or toothed-ring connectors and bolts between curb timbers to make an adequate transfer of the load of a striking automobile. For spans from 24 or 36 to 60 or 80 ft, shallow timber-connector deck trusses may be used, while for spans from 60 to 100 ft, low timber-connector trusses with solid or trussed floor beams and a laminated timber or composite timber-concrete floor may be used. Beyond that approximate limit through timber-connector trusses have been built successfully. Continuous timber-connector trusses are believed to be within the



Harbor Plywood Corporation

EIGHTY-FIVE PER CENT OF THIS COMBINATION GYMNASIUM-AUDITORIUM AT WHITE SALMON, WASH., IS STRUCTURAL PLYWOOD

Plywood Was Used for the Side Walls, Roof, and Interior Finish, and in the Roof Arches

range of practical possiblity. A useful life of fifty or more years may be predicted through the use of effectively preserved timber and galvanized hardware.

The novel footbridge joining the Administration Building of the 1939 New York World's Fair with other parts of the grounds uses a unique and pleasing laminated timber roof curved so as to be supported by parabolic arches.

Another common form of laminated timber construction is represented in the top chords of timber bowstring roof trusses. Frequently the top chord contains laminations bent to a circular or parabolic curve and nailed securely, allowing an extra line of laminations to compensate for insufficient section at the joints between laminations. In other cases bolts and nails are used, and frequently glue, bolts, and nails are all used in the same chord. The most satisfactory laminated timber chord, however, uses only a water-resistant glue and carefully beveled, lapped, and glued connections between the ends of individual laminations so that the full section may be considered effective (Fig. 4). Two such curved chord segments are used with web bracing members between and connected to them by bolts or connectors, depending on the loads to be carried.

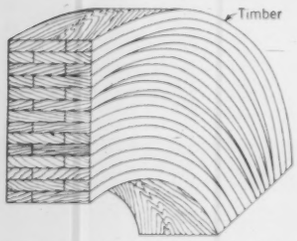
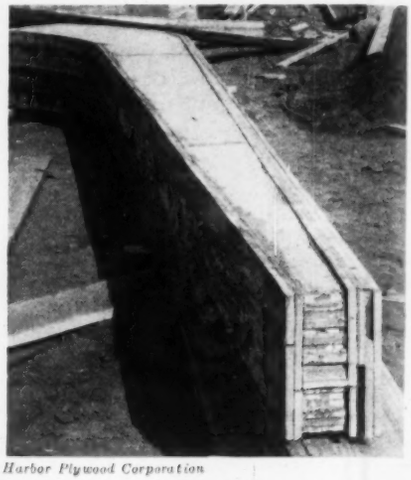


FIG. 4. LAMINATED GLUED TIMBER ARCH OR FRAME

Large one-piece timber walking beams used in connection with oil drilling operations sometimes develop shakes or checks that impair their resistance to horizontal shear. To overcome this difficulty, such beams are now built up using a number of separate horizontal timbers bolted together with split-ring connectors between their contact surfaces sufficient to resist horizontal shear. The resilience of such timber walking beams is considered desirable by drillers. Similar assemblies may be used where large-section timber beams are desired, either simply supported or continuous. (Fig. 5.)

Partially continuous timber stringers (Fig. 6) are simple to design, fabricate, and assemble using a system of placing alternate joints at approximately the quarter points of the spans, and transferring the end reactions of these spliced laminae to the adjacent laminae that continue past the splice, forming a beam or stringer in which a degree of continuity is secured without the use of individual laminae two spans in length. Timber connectors may be used to transfer the load at joints. The full section of the timber is effective in resisting positive bending moment at the center of the span and negative bending moment over the supports, while the remaining section of the timber at the quarter points of the spans usually is adequate to carry the maximum positive or negative bending moment that may be delivered to it by uniform or moving concentrated loads. At the same time difficulty caused by inadequate bearing at the ends of the stringers is avoided because there are no splices over the supports. Such assemblies are practical for use in open-deck timber railway trestles, continuous highway stringer bridges, or continuous beams in industrial buildings. Such units may be assembled in considerable length because the change in length of timber parallel to the grain under temperature change is so small as to be negligible in most cases.



Harbor Plywood Corporation

STRESSED COVERED RIGID BENT, FOR WHITE SALMON GYMNASIUM-AUDITORIUM BEFORE TRIMMING

Note Laminated Plywood Core, Two Layers of Solid Wood in Compression Course, and Four Layers in Tension Course

A modification of laminated timber construction, using bolts and timber connectors, is the assembly of timber compression members, such as truss chords, into what are called "spaced columns" (Fig. 7). Such members consist of two or more parallel relatively wide and thin laminations separated at their center by a spacer block held in place by a bolt, and at their ends by longer spacer blocks held in place by bolts and split-ring or toothed-ring connectors. Through the use of plywood gusset plates, or the lapping of timbers at joints, and the use of connectors, the equivalent of end spacer blocks is provided in timber truss joints. Thus it is no longer necessary to use heavy solid timber compression members, usually quite excessive in size, in order to provide adequate resistance to lateral deflection and transfer of load at joints in timber roof or bridge-truss compression members.

Glued laminated timber construction may be thought of as having two forms—one in which the grains of adjacent laminae are parallel to each other and another in which they are at right angles.

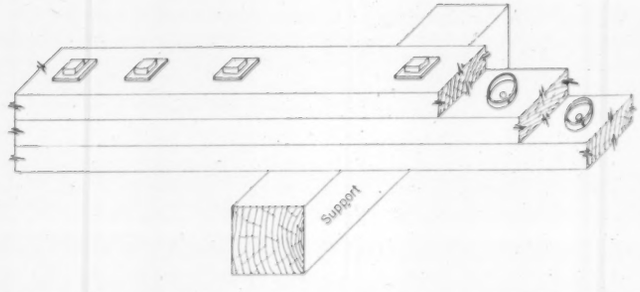


FIG. 5. BUILT-UP TIMBER-CONNECTOR BEAM WITH HORIZONTAL LAMINATIONS

The principal present use of glued laminated parallel-grain timber construction is in roof arches and frames and, as mentioned earlier, in the top chords of timber bowstring roof trusses. Many structurally adequate and esthetically pleasing churches, community centers, auditoriums, gymnasiums, dance halls, domes, and band shells have been built in the United States using this type of construction. Such units may be shaped to meet both structural and architectural requirements and may be bent, cut to any desired cross-section, surfaced, stained, engraved, or otherwise finished in many beautiful ways, and left exposed to view on the interior to give that

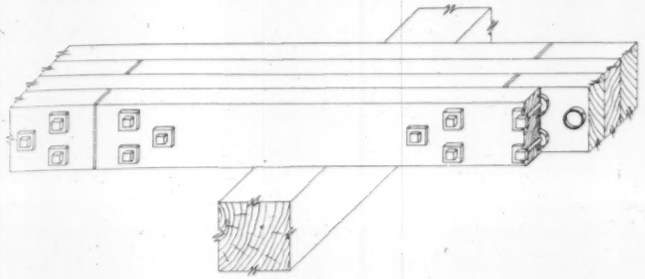


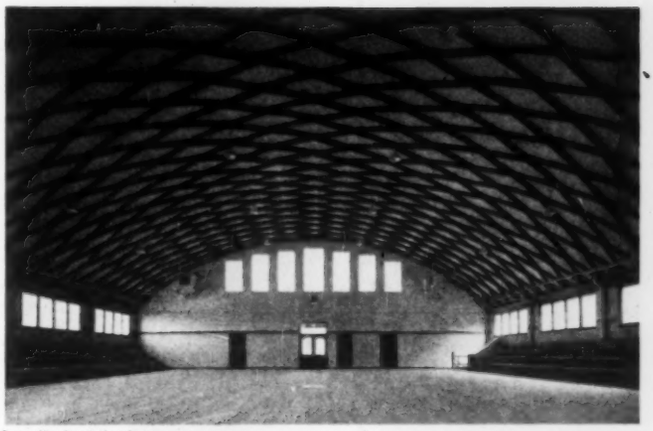
FIG. 6. PARTIALLY CONTINUOUS TIMBER-CONNECTOR STRINGER WITH VERTICAL LAMINATIONS

appearance of massive strength characteristic of timber. This type of construction has been tested by the Forest Products Laboratory and the Experiment Station of the University of Illinois. The laboratory reports that when individual laminations of curved glued laminated parallel-grain members are bent during the process of manufacture to a radius as sharp as possible without breakage, the strength of the resulting assembly remains 75% as great as that of a corresponding straight glued laminated timber member. Similarly, when the ratio of the radius of bend to the thickness of individual laminae is 150 or greater, the strength of the member is 90% of the strength of a straight member.

Cross-banded glued laminated timber construction was introduced in the United States 58 years ago. Today it is called "plywood" and is manufactured from practically any species of timber using any type of glue and pressing process. The major part of the plywood for structural uses, however, is produced from Douglas fir because of the large-size logs available, the strength of that species of timber, its freedom from resins and imperfections, and the large proportion of heartwood to sapwood.

In order to understand structural plywood, it is necessary to understand the bonding mediums used between the laminations. Glues commonly used in woodworking are prepared from animal products, blood albumin, casein, vegetable protein, or starch. Animal products and starch glues are usually mixed with hot water but are applied and pressed cold. Blood albumin glue is mixed and applied cold but requires a hot press to give it a quick-setting high strength. Casein and vegetable protein glues are mixed and pressed cold, are high in strength when dry but, like animal products and starch glues, are low in moisture resistance.

Recent research has produced a number of phenolic resin glues in the form of dry-film, aqueous suspensions, dry powders, or non-aqueous solutions. These resin glues are high in strength and, together with blood albumin glue, have a high resistance to moisture. Most of the resin glues require a hot press exerting high pressure which fuses the glue into the plies to a depth of about $^1/_{16}$ in. The toxic properties of these chemicals introduces a high resistance to decay or attack by insects. During manufacture plywood using aqueous glues is carefully dried at about 120 F to a moisture content of from 7 to 15%, while the moisture content of hot-pressed resin-bonded plywood is controlled so that subsequent drying is not necessary.



Lamella Roof Syndicate, Inc.

LAMELLA ROOF STRUCTURE AS USED IN A HIGH SCHOOL GYMNASIUM
The Span Is 72 Ft, Height at Side Walls 11 Ft 6 In., and Height at Center 26 Ft 6 In.

The use requirements of plywood determine the degree of moisture resistance and strength necessary. A hot-press resin-bonded plywood should be used for permanent exterior exposure, marine construction, or unusually damp conditions. Plywood using a cold-press casein or vegetable protein glue of known high moisture resistance should be specified for concrete forms or open-trench sheeting. A plywood meeting moisture-resistance standards of the U.S. Bureau of Standards should be used for sheathing, wall board, and industrial uses.

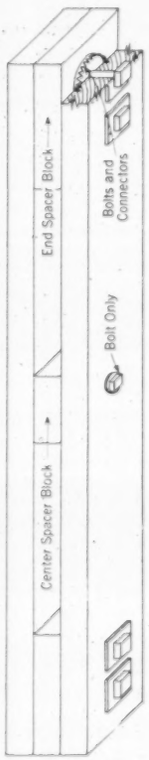


FIG. 7. THE SPACED COLUMN

The strength of the glue line of plywood is stronger than the wood itself and the cross-banding of the laminations places about half the plies with their grain perpendicular to shearing and bending stresses. Resistance to bending, tension, or compression on plywood plates is computed taking into account only the plies whose grain is parallel to those stresses. Resistance to vertical or horizontal shear, or to diagonal tension or compression, on plywood plates takes into account all plies and is quite high.

Plywood is particularly adapted to the production of low-cost prefabricated houses employing boxed sections formed from plywood plates nailed and glued on each side of studs or joists. These sections can be fabricated in quantity; can be standardized as to size and shape, and filled with insulating material or left empty; and can be used for floors, walls, partitions, ceiling, or roofs. Such sections have been tested at the Forest Products Laboratory, and test houses have been built there and at Purdue University.

Among other present or potential uses of structural plywood should be mentioned gusset plates (Fig. 8) and plate girders (Fig. 9), arches or frames (Fig. 10), and built-up columns (Fig. 11). Thick plates of hot-press resin-bonded plywood

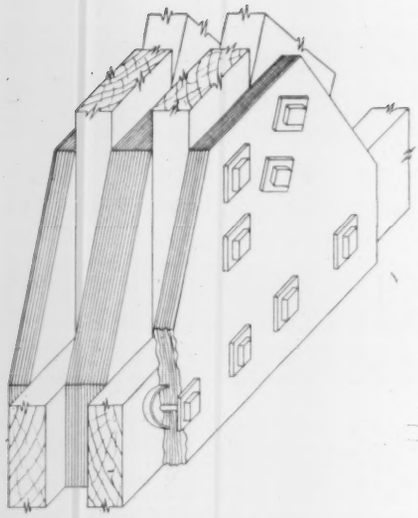


FIG. 8. TYPICAL TIMBER TRUSS JOINT USING PLYWOOD GUSSET PLATES AND CONNECTORS

have been cut to shape, bored, grooved for connectors, and used as gusset plates to simplify otherwise complicated timber connections in many California timber-connector highway bridges. Several years ago a timber plate girder using a spliced structural plywood web plate with solid timber connected to its edges with bolts and connectors forming a plate girder, was tested at the University of North Dakota and gave results consistent with predicted behavior and load-carrying ability. Built-up plywood-timber three-hinged arches, similar to that shown in Fig. 10, were used in the Service Building at the Forest Products Laboratory. An unusual adaptation of this combination of materials partly similar to Fig. 11, was to be seen in the Colonnade of States as part of the Federal Exhibit Building at the Golden Gate International Exposition at San Francisco.

Another recent outstanding use of structural plywood is in an auditorium-gymnasium building at White Salmon, Wash., in which three-hinged arches have been used to support the roof, while the walls and roof are formed from prefabricated box sections of plywood on studs or joists. These arches are formed by gluing together plywood plates in parallel vertical planes, cutting the assembly to the shape of the arches, and adding lapped and bent laminations on top and bottom of the arches normal to the planes of the plywood and glued to it. Such arches possess the required strength, are easily assembled, present a pleasing interior appearance, and result in a minimum depth of roof construction.

Another modern development in the manufacture and use of plywood is its combination with metal. Metal-sheathed plywood is now manufactured using practically any species of timber with any desired metal sheets effectively attached to one or both faces of the panels Such metal-sheathed panels provide a greatly increased strength and resistance to wear, and increased resistance to fire, sound-deadening properties, and heat-retention ability superior to single metal sheets. Use of phenolic resin glue renders such metal-sheathed plywood plates impervious to attack by insects, and treatment with fire-resistant chemicals leaves them subject to combustion only by heat from other burning material.

Metal-sheathed plywood is used in modern railway passenger equipment, truck and trailer bodies, restaurants, drug stores, hospitals, and kitchens. Similar sheets are manufactured using a single metal core to which is added cross-banded laminations, and faced on one or both sides with a veneer. Such sheets are used where light weight, strength, and beauty are desired, as for instance in elevators.

LAMELLA ROOF CONSTRUCTION

An unusual, practical, and economical type of roof-supporting structure introduced from Europe several years ago, is being used successfully in such American structures as churches, auditoriums, gymnasiums, dance halls, riding academies, sports arenas, garages, and industrial buildings. It is known as "Lamella" roof construction, and consists of an ingenious network of diagonal compression members so interwoven as to form a pattern of diamond-shaped openings, and so connected at their ends as to transmit thrust and end reactions through the network to its supports. This network is erected in place on falsework to form tied or buttressed circular arches, three-hinged arches, roof construction with rounded ends, and half or full domes. The tops of the lamella timbers are cut to the curve of the arch and sheathed. This sheathing serves to provide a surface for the application of roofing material, to provide lateral support for the individual lamella, and to serve as lateral and longitudinal bracing for the entire roof. Insulation is introduced inside the diamonds or on the inner edges of the lamella; or a ceiling may be suspended from the roof by steel hanger rods.

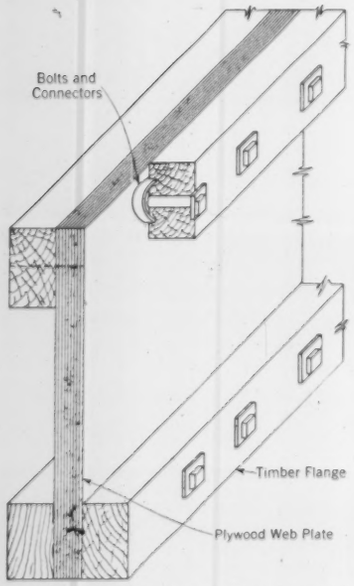


FIG. 9. PLYWOOD-TIMBER PLATE GIRDER

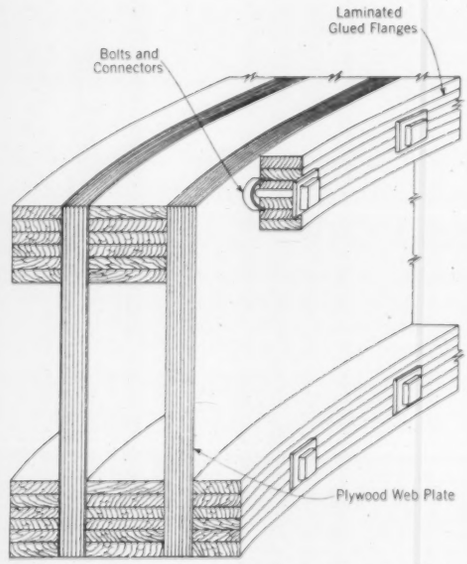


FIG. 10. LAMINATED GLUED PLYWOOD-TIMBER ARCH OR FRAME

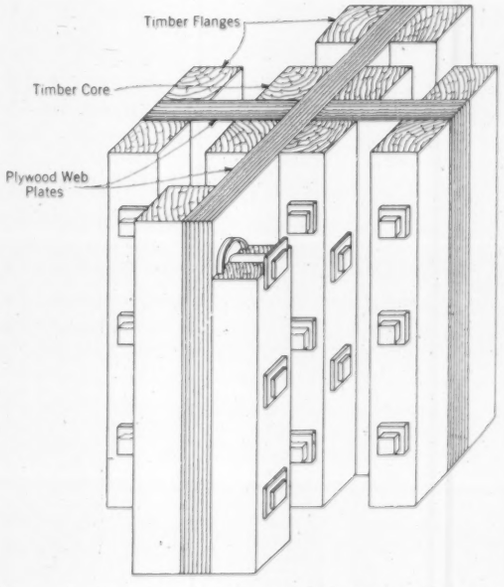


FIG. 11. SUGGESTED PLYWOOD-TIMBER BUILT-UP COLUMN

Concrete Linings for Irrigation Canals

By CLYDE W. WOOD

ASSOCIATE MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
PRESIDENT, METROPOLITAN CONSTRUCTION COMPANY, LOS ANGELES, CALIF.

THOUGH concrete ditch lining is not a cure-all for the operating problems of an irrigation project, says Mr. Wood, its economic value is too well established to need comment. In the accompanying article he reviews briefly the history and results of work on two large projects in California, where lining programs have been in progress for a number of years, and concludes with a description of the highly mechanized methods of lining construction employed on a number of more recent jobs. The paper was originally presented before the Irrigation Division at the 1939 Annual Convention.

THE economic value of canal lining has long been an established fact. Irrigation engineers need no sales talk to persuade them to use it; rather, they are looking for a magician to pull the necessary finances out of a hat so that they can start work. The value and necessity of canal lining are determined by the scarcity of the water supply, the cost of maintenance and operation, and the need for equitable water distribution and control of seepage losses and ground-water levels—all of which in the final analysis relate to control of alkali and permanency of development. A study of these factors will determine when, where, and how much lining a project can afford.

Linings of some kind have been used since irrigation began. Clay blankets—once the most common type—are occasionally still used, as witness sections of the All-American Canal. Many ditch systems have sluiced clay into their canals to be distributed and infiltrated into the subsoil by the stream flow. Cobbles, riprap, masonry, oil and asphaltic mixes have been and are being used, but the trend has long been toward concrete as best meeting all the hydraulic and economic requirements of a permanent development.

Water has always been scarce in Southern California, and the development of the citrus industry has made it extremely valuable, so it is natural that the earliest concrete-lined canals in California, dating back to approximately 1885, are to be found around Pomona and Riverside. Many of these early linings are recorded as having been only $^1/_4$ to $^1/_2$ in. thick. Experience soon demonstrated that 1 in. was about the practicable minimum, and many sections of this thickness have been in continuous operation for more than 40 years. However, the subgrade drainage is perfect, and there is no trouble from frost or alkali. Many of the side slopes of these early ditches were 1 on 1. Because of the extremely high water duty and the value of water in Southern California, practically every ditch is concrete lined, except in the Imperial Valley District.

In central California, because of a more plentiful supply of water, and the medium and low-priced crops produced, concrete lining of canals prior to 1915 was limited to sections of main canals in mountain reaches, where it was needed because of high velocities and other hydraulic elements involved.

LINING PROCEDURES IN THE TURLOCK DISTRICT

As an example of lining work in this area let us review procedures in the Turlock and San Joaquin districts. The Turlock Irrigation District began operation in 1900 and its development was slow for the first few years. Its point of diversion is La Grange Dam about 30 miles east of the district. It comprises 185,000 acres of land, much of it of a light sandy nature. Its system of main canals and laterals is 250 miles long. In the early years the district was sparsely settled and the settlers were widely scattered over the whole area and the whole mileage of canal. It was a real adventure to undertake to deliver a head of water through some of the ditches, especially those the farmers had built cooperatively.

Measurements made in 1911 by the writer (as hydrographer of the district) showed that $6^1/_2$ acre-ft of water was being diverted at La Grange per acre irrigated. After hundreds of measurements we guessed that we delivered about half of this quantity to the patiently waiting farmers. This was before any storage was available.

Rapid settlement necessitated rapid enlargement and improvement of the canal system. This development started in earnest in 1910, under the direction of Burton Smith, and has been carried on continuously since 1913 by Roy Meikle. He was able to sell the idea of canal lining on some bad fills in 1915 and continued the selling job year by year in the bad spots.

Excessive seepage and excessive use brought the drainage and reclamation problem quickly to a head in this district, and on the theory that an ounce of prevention was better than a pound of cure, special assessments amounting to approximately $100,000 were levied year after year to expedite the canal lining program. A special bond issue of $550,000 was voted in 1920 to still further expedite this work. The district is fortunate in now having revenue from power at Don Pedro Dam; surplus funds from this source are used for lining and other improvements needed in the district. With these funds and grants from the PWA, $500,000 worth of additional lining has been placed in the last two seasons.

Early construction consisted of gunite of $1^1/_2$-in. thickness reinforced with galvanized mesh used on the larger canals, and a 2-in. placed lining, unreinforced, in the smaller ditches. Today standard practice in this district consists of a 2-in. placed lining with 1 on $1^1/_2$ side

SUBGRADER, FITTED WITH LONG DISPOSAL CONVEYOR BELT FOR USE IN DEEP CUTS, AT WORK ON CONTRA COSTA CANAL

slopes. Extensions are being continued yearly as funds are made available.

Throughout the years the Turlock Irrigation District has maintained a very high standard of construction. A great deal of its work has been done by district forces and, in times past, through labor contracts with local farmers. The district was very fortunate in having within its boundaries a large number of Scandinavians

CONCRETE FINISHING MACHINE IN A DEEP CUT ON THE CONTRA COSTA CANAL

who are not only excellent farmers but skilled artisans. These men formed several small construction units and did a lot of excellent and cheap canal construction for the district. And because they lived at home and this income augmented their farm income, they were satisfied with a comparatively low wage.

Mr. Meikle reports the average cost, including the necessary dirt work, as about 8 cents per sq ft. Small private ditches of 15 to 20-cu ft per sec capacity cost about $4,000 per mile. District laterals carrying from 100 to 200 cu ft per sec cost from $6,600 to $11,000 per mile.

FARMERS ENCOURAGED TO LINE DISTRIBUTION DITCHES

Today the Turlock District, out of a main ditch system of 250 miles, has over 135 miles of canals and laterals lined with concrete. This is 55 per cent. The distribution ditches, which are still privately owned by farmers, are estimated to total about 900 miles. The district has encouraged the farmers to improve these ditches by offering free engineering and supervision of construction, and by a special state legislative act has enabled them to form "Improvement Districts" through which they issue 10-year bonds at 5 per cent. Over 200 of these little districts have been formed, $500,000 in bonds issued, and so far there have been no defaults. To date 122 miles of ditches have been lined with concrete, and 210 miles replaced with concrete pipe. This means that 37 per cent of the private system is improved.

The results of concrete lining have been very conclusive in the Turlock District Maintenance and upkeep of lined canals, some of them over 20 years old, have been negligible. The operating cost is only a fraction of what it was before, as there is no need for patrolmen other than ditch tenders making actual water deliveries.

MANY ADVANTAGES OF LINED CANALS

However, the true value of a concrete-lined ditch system is not so easily converted into dollars. While it can be shown that concrete ditches will pay for themselves many times over from the standpoint of maintenance and operation alone, their real usefulness starts—in the hands of an intelligent operator—in helping to bring about a more efficient use of water, a better distribution enabling greater varieties of crop, and an aid to control of ground-water levels and of potential alkali damage.

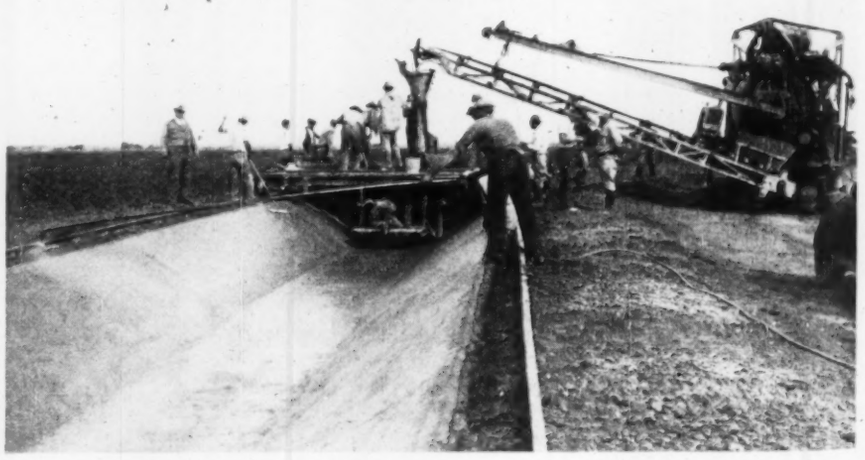
To quote a recent letter from Mr. Meikle, "Concrete canal lining saves water in transit and if conditions remained the same in the irrigated area a very definite saving of water for a project could be shown by concrete-lined canals over earth canals. . . .

"In 1926 the Turlock District diverted from La Grange intake 3.41 acre-ft per acre irrigated, and pumped into the system from wells during the irrigation season 0.38 acre-ft per acre, 10 per cent of the requirements for a total of 3.79 acre-ft per acre. For the year 1936 the La Grange diversion amounted to 2.99 acre-ft per acre, the pumping from wells 0.85 acre-ft per acre, or 25 per cent of the whole."

I wish to point out that although this district has added more miles of lined canal each year, it has also increased its drainage pumping until today it provides one-fourth of its total water requirements from this underground reservoir and thus is very definitely safeguarding its permanency.

Again quoting Mr. Meikle, "The figures indicate that the total amount of water used per acre remained practically the same during the 11-year period. The diversion from the river decreased and the pumping increased. During the period the ground-water level was held at the same level. The number of all irrigation deliveries in the area increased from 20,268 to 30,371, or about 50 per cent, while the irrigated area increased only 13 per cent. With a large number of canals and ditches concrete lined, the district is able to make irrigation deliveries on a 10-day rotation period as compared with a 30-day rotation some years ago.

"Under the system here the irrigator pays a fixed tax, which averages about $2 per acre regardless of the



FINISHING MACHINE USED ON A SMALL CANAL (4-FT BOTTOM WIDTH) IN THE WEST STANISLAUS IRRIGATION DISTRICT

amount of water used. This condition does not encourage the frugal use of water. The loss of water into the ground while irrigating our rather large checks in sandy soil varies roughly from 25 to 50 per cent of the water applied. With more frequent irrigations the irrigator applies about twice the amount of water, irrigating every two weeks, that he did irrigating every month.

"Our lining program has made it possible to deliver water to the irrigators practically on demand or when required by any crops grown in the district. Under our system, we feel concrete lining and drainage pumping go hand in hand. . . .

"The concrete-lined distribution system provides a means of delivering irrigation water over a large area without delays due to breaks and at about double the velocity used in earth canals. Practically all of the water is delivered where required rather then added to the ground water by seepage over the length of the earth ditch.

"In my opinion drainage by pumping will always be required in this district because I see no practical method of applying water on a large scale with less than a 25 per cent loss into the ground water."

JUMPING STORM DRAIN SIPHONS WITH HEAVY CANAL EQUIPMENT—METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

DITCH LINING IN THE SAN JOAQUIN DISTRICT

The South San Joaquin Irrigation District, comprising 73,000 acres, is also located in the Central Valley, 40 miles north of the Turlock District. Its source of supply is from the Goodwin Dam on the Stanislaus, which like Turlock's supply is 30 miles east of the district. It differs from Turlock in that the canal and lateral system was extended to each governmental unit of 40 acres and hence contains 350 miles for 73,000 acres as against 250 miles for 185,000 acres at Turlock.

Originally (1914) something over 40 miles of the main canal was concrete lined. This lining was 4 in. thick and unfortunately was built on a 1 on $^1/_4$ side slope. Back pressure from a heavy rain or a quick drop of only 1 ft in the canal level was usually sufficient to send some more of the lining to the bottom of the ditch. In the face of these failures, which continued year after year, it was difficult to sell the directors and the taxpayers on the need and permanency of a canal lining program. The building of ditches to each 40-acre plot did greatly expedite the settlement of the district. But the immediate use of large volumes of water soon brought about an acute need for drainage and reclamation. Old man alkali commenced to sit up and look us in the face. It was recognized and advocated from the beginning that a canal lining program should go hand in hand with the drainage program, but the heavy bonded indebtedness and the heavy maintenance and replacement of the wooden structures used in the original construction made the financing an impossibility. A small start was made in 1918 by the lining of one bad fill each year, but it was not until 1924 that the district voted a half-million-dollar special bond issue to make a real start on the problem. With this money 55 miles of 1-in. gunite lining reinforced with galvanized wire mesh, and 10 miles of 2-in. lining unreinforced were placed. Since then, out of many special assessments, WPA and PWA grants, the district has succeeded in lining another 50 miles of canal.

The present engineering staff reports most of this lining in good condition. However, failures have occurred in the 1-in. gunite where the wire mesh was not properly covered with concrete. Experience has shown that a 2-in. unreinforced lining can be placed for about the same cost as the lighter gunite and that the "human equation" is not so vital in the heavier lining. All the improvements of recent years have been of the 2-in. hand-placed concrete on 1 on $1^1/_2$ slopes. The cost of this work is stated to be 7 cents per sq ft. Great savings in operation and maintenance are recorded here also as well as savings in transportation losses and elimination of seepage damages. However, over 200 miles of district-controlled ditches still remain to be lined.

Mr. Campbell, the present engineer, states: "Transportation losses in our unlined canals are very heavy, in some cases, in ditches carrying 30 cu ft per sec or less, running to 3 cu ft per sec per mile. This causes a high water table with its well-known detrimental results. In former years the lands were planted to crops requiring 20- to 30-day irrigation periods, mostly alfalfa. Now crops are changing to other varieties—sweet potatoes, melons, lettuce, clover, corn, etc., requiring 10-day service. We are confronted with the problem of either curtailing these crops or lining the ditches leading to these sections."

This district, like Turlock, levies a tax based on valuation and not on the water used. When the writer tried to check up on the effect of this lining on the water duty obtained, one of the engineers responded, "Water duty? What does a farmer care about water duty? They still demand all the water they can get and we give it to 'em." And how can the poor engineer do otherwise? This, coupled with the false idea that with concrete lining drainage is not so urgent, has prevented this district from realizing all the potential values of its lining program. Drainage and reclamation from alkali are still serious problems here, and while concrete lining will help to solve them, only the application of common sense to the use of water can insure a permanently successful irrigation development here, or elsewhere.

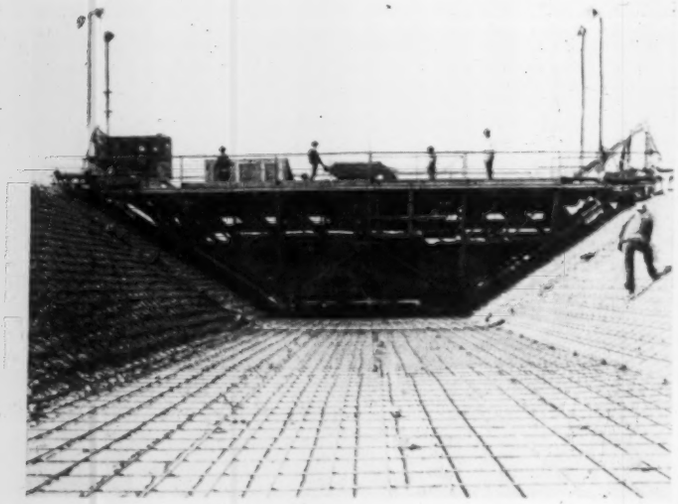
All the lining done by these two districts has been placed by what is now referred to as hand methods. The needed reshaping of the section was largely accomplished with fresno teams. The subgrade was trimmed by hand and the sandy soil made it possible to do an excellent job cheaply. Concrete was distributed from 1- and 2-sack mixers in wheelbarrows and concrete

buggies. These farmers and farmer contractors have reason to be proud of the work done. Labor was plentiful, reasonable, and highly efficient.

Today it is different. High wages required by the so-called prevailing wage law have forced the adoption of new, highly mechanized methods so as to keep the cost within the reach of the market.

MACHINERY DEVELOPED FOR GRADING AND LINING CANALS

Construction of long sections of large-size canals by the Metropolitan Water District in Southern California presented the opportunity to develop some very efficient equipment that did precision work in the grading of subgrades and the placing of concrete. The climatic conditions encountered in the desert, coupled with our inability to compete with the WPA, made it necessary to avoid hand labor as much as possible. Also, the subgrade material varied from blow sand that could not be kept in place, to a very hard calecia and cemented gravel, and was not adapted to hand grading except at great cost.



STEEL PLACEMENT AHEAD OF CONCRETE FINISHING MACHINE—A VIEW ON A METROPOLITAN WATER DISTRICT CANAL

Subgraders moving on rails set to line and grade and resembling two trenching machines working in opposite directions and crosswise of the ditch were developed to take over behind the draglines, and to complete it with one pass to final grade. This machine was followed by a "moving form" the exact size of the lined ditch, through which concrete was delivered from 2 to 3 standard road pavers at the rate of 700 cu yd to 1,000 cu yd in an eight-hour shift. This concrete was 8 in. thick at the bottom of the ditch, tapering to 6 in. at the top, heavily reinforced to take care of all temperature stresses. The concrete was placed monolithically at the rate of 1 to $1^1/_2$ lin ft per minute, or 60 to 90 sq ft per hour, the only joints being the daily construction joints. The precision obtained is best illustrated by the statement in the engineer's final report that "the overbreak averaged less than $^1/_8$ in. for the entire 62 miles." Internal vibration on canal lining was first used here as an aid to the placement and solidification of the concrete. Great care was taken with the mixes and a very high grade of concrete was obtained. To date this is the largest lining placed monolithically, although it is by no means the largest possible.

Mechanical trimming of subgrade and placement of lining are applicable to ditches of all sizes, as similar equipment was used on a contract for 32 miles of laterals for the West Stanislaus Irrigation District at Westley, Calif., where the bottom widths varied from 3 to 5 ft, and the depths from $2^1/_2$ to 4 ft. All side slopes were 1 on $1^1/_2$ and the concrete was 2 in. thick. Two million square feet were involved and the contract price, including the grading, was 9 cents per sq ft. Often 3,000 lin ft of these small ditches was completed in a day with one set of equipment. Internal vibrators were not used on this job but I feel that it would be economy to include them on future equipment of this nature. The work was done in 1935–1936 under a PWA grant and loan, using relief labor, and it is too recent to present any maintenance problems.

This district contains 22,000 acres and 68 miles of canals, of which 45 miles are lined with concrete. It pumps its water from the San Joaquin River with an average lift of 100 ft and differs from the others mentioned in that it levies a general tax, plus a toll charge on water used. This offers the incentive, lacking in the other districts, to economize on the water consumption. As reported by Mr. Wooley, its manager, the gross diversion per acre irrigated is 1.95 acre-ft and, because of the large percentage of ditch lined, the net delivery is 1.66 acre-ft per acre.

Ditches of intermediate sizes have also been placed successfully with this type of equipment, some of them under rather trying conditions as to subgrade and terrain. Notable among these are the Roza Canal in Washington for the Bureau of Reclamation, and the Contra Costa Canal (now under construction) near Pittsburg, Calif. Internal vibration has been used throughout and some very satisfactory results have been obtained.

LACK OF STANDARDIZATION COSTLY

One of the difficulties of adapting mechanical equipment to canal construction is the lack of standardization of sizes and shapes of section. It is surprising what a great variety of cross sections may be developed for a ditch through which to run 50 cu ft per sec of water, and what effect this lack of uniformity may have on the cost of construction. On one project recently a change of $1^1/_2$ in. in depth of section was made, resulting in a saving in concrete of less than $150 and costing $200 to provide the necessary adjustment in the equipment. So far all the equipment developed and used has had to be tailor made for each job with some rather expensive adjustments needed for the changes of section as designed on a single ditch. It seems logical that steps could be taken to reduce these sections to a number of standard sizes to enable the economical manufacture of equipment, so that the fullest use could be made of these new methods to offset rising labor costs.

In conclusion, it should be stressed that though concrete ditch lining is an economic necessity it is not a cure-all. The most important factor making for successful and permanent irrigation development is the study of the proper and efficient application of water to the land. And the most important people in this work are not the designers and constructors, but those engineers who have given their lives to the operation and management of irrigation projects. They have been the missionaries, preaching the gospel of correct use, correct drainage, and even correct preparation and planting of the land. They have carried on the prosaic task of correcting the mistakes of the designers and constructors—which have been many. They have discovered and instituted the operation technique around which has been built the science of irrigation engineering. The future of irrigation in this country rests on their shoulders.

Provision for Seismic Forces in Design of Golden Gate Bridge

Analyses Show Earthquake Stresses to Be Small and Within Limits of Structural Design Stresses

By Leon S. Moisseiff

Member American Society of Civil Engineers

Consulting Engineer, New York, N.Y., and Member of Board of Consulting Engineers on Golden Gate Bridge

THOUGH the Golden Gate Bridge was completed in 1937, the accompanying article is believed to be the first to discuss in detail the analyses of earthquake forces involved in its design. It will be noted that the flexibility of a suspension bridge is of great assistance in resisting earthquake. Moreover, as Mr. Moisseiff points out, the frequency of a destructive quake can never be in resonance with that of any part of the Golden Gate structure. As a result, the effect of the "design quake" on the superstructure is less than that of a wind load of 30 lb per sq ft, and the highest shears induced by it in the substructure are not more than 10 lb per sq in. This paper was originally presented before the Structural Division at the 1939 Annual Convention of the Society.

PLANNING of structures to sustain the effects of earthquake without undue distortion and rupture is still in a tentative and crude stage. This is not because engineering knowledge is insufficient to cope with the proper design of structures for known forces, but because the data on earthquakes are as yet meager and the knowledge of their effects is still vague. Available are instrumental observations on the period of time in which a full vibration took place during a given earthquake and the record of such vibrations in various localities; also available are observations on the distance an object has swayed from its position of rest to either side, known as the amplitude. From such information, a knowledge of the forces acting on structures during an earthquake must be deduced. Barring the chance that a fault may be produced at the site of the structure which would destroy it, we aim to determine from the observations the forces attacking the structure and design it to resist them.

To translate the phenomenon to computable form, it is assumed that an earthquake will approximate a simple harmonic motion. The assumption leads to a simple mathematical expression for the maximum acceleration:

$$a_{max} = \frac{4\pi^2}{T^2} \times A$$

wherein A is the amplitude in units of length; T, the period of time of full vibration, in seconds; and a, the acceleration in units of length per second per second. Both amplitude and period are independent quantities and must be evaluated from observations. Records of destructive earthquakes show relatively small amplitudes—seldom exceeding 1.5 in.—and a minimum period of vibration of approximately 1.35 sec.

To evaluate the effect of earthquakes in the San Francisco region for the Golden Gate Bridge, an amplitude of 1.24 in. and a period of 1.3 sec were assumed. For these values a maximum acceleration of 2.42 ft per sec per sec—that is, $0.075g$—results. From theoretical studies and observations on models it is known that if the free or natural frequency of a structure or of its integral parts is in resonance with the frequency of the actuating cause, destructive stresses are developed. It is assumed that all parts of the structure are sufficiently connected to each other to assure full interaction during the earthquake.

The natural frequency of masonry blocks such as the piers and anchorages of the Golden Gate Bridge is but a fraction of a second. The natural frequency of the superstructure is between 5 and 25 sec, depending on the direction of the earthquake movement. The frequency of a destructive earthquake can thus never be in resonance with that of this structure or any part of it. It was therefore considered justifiable to translate the effect of earthquake into static forces acting on the structure.

ASSUMPTIONS USED IN DESIGN

The greatest acceleration assumed for the superstructure and the anchorages is $0.075g$; for the main piers this was, however, increased to $0.10g$. A solid body which does not elastically deform would thus be subjected to a horizontal force of $7\frac{1}{2}$ or 10% of its weight acting at the center of gravity. This is true for the piers or anchorages but will not be fully applicable to the superstructure because of the flexibility of the latter.

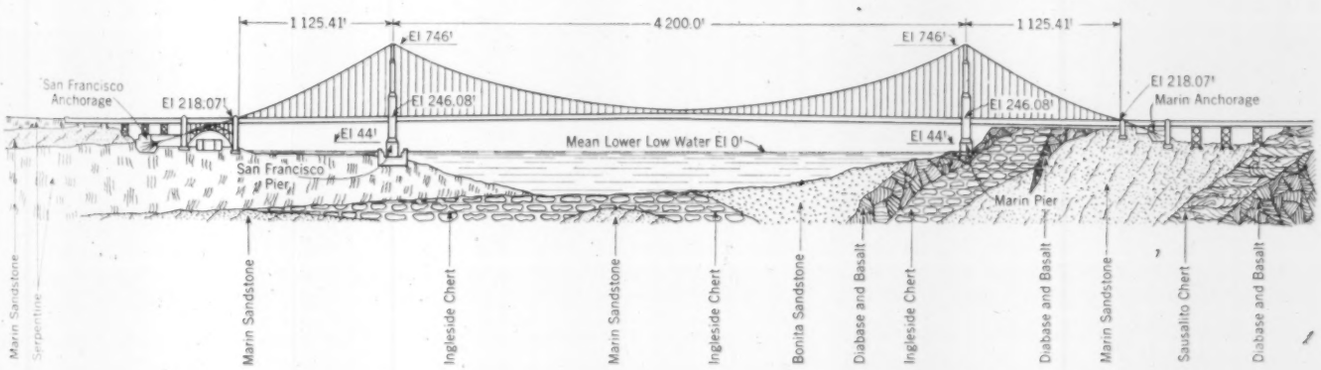


FIG. 1. GENERAL ELEVATION OF GOLDEN GATE BRIDGE

The acceleration exerted on the ground will lose itself gradually in deflections of the structure. With the present knowledge of earthquakes it may be assumed that that part of the foundation

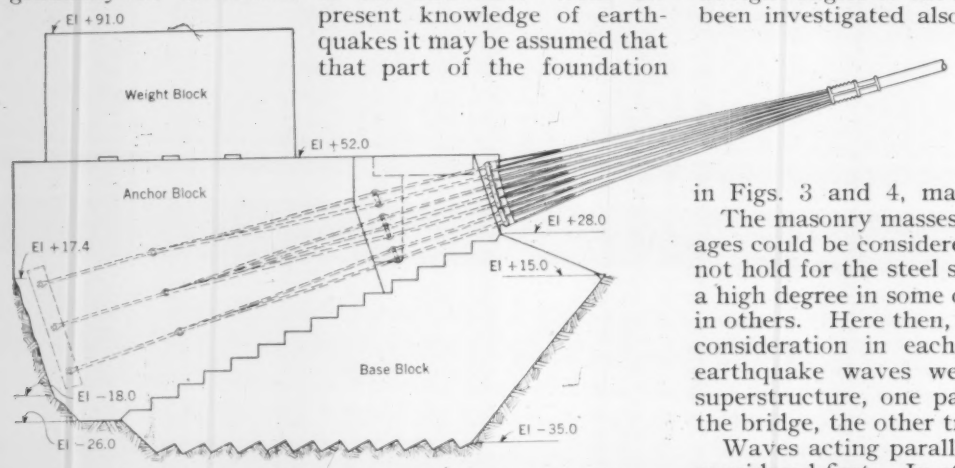


FIG. 2. ELEVATION OF SAN FRANCISCO EAST ANCHORAGE

which is firmly embedded in rock is part of the latter and will not induce stresses. The inertia of the concrete mass rising above the rock, however, will cause stresses. A more detailed result of the analysis will be given in the following paragraphs. For the location and general arrangement of the elements referred to, see Fig. 1.

For waves parallel to the longitudinal axis of the bridge, the effect of earthquake on the anchorages (Fig. 2) is dependent on two principal causes, the increase of the cable tension and the relative difference in momentum of the various parts of the anchorage. A horizontal force produced by an acceleration of $0.075g$ was assumed to represent the greatest earthquake effect on the anchorages. This will increase the cable stress by 7.5% and also produce a horizontal force in the anchorage in the same direction equal to 7.5% of the weight of concrete above the assumed plane of slippage and acting at the center of gravity of the mass.

The increased horizontal component of the cable tension amounts to 63,652,000 lb per cable.

Since the whole San Francisco east anchorage is below the original ground line, only the weight block was considered to accelerate with respect to the rest of the anchorage. The slippage plane was assumed at El. +52.0. This assumption results in a horizontal force of 1,630,000 lb. In the case of the San Francisco west anchorage, the ground line being lower, a horizontal slippage plane has been taken at El. ±0.0, resulting in a horizontal force of 6,960,000 lb. It has been found that stresses on the base block as well as on the foundation rock are but little affected; all stresses are within safe limits.

For the Marin anchorages, the plane of slippage has been taken along the construction joint separating the base blocks from the anchor blocks. The horizontal force due to the accelerated masses of concrete amounts to 5,766,000 lb for the east anchorage and 5,466,000 lb for the west anchorage as compared to a cable pull (including increase due to earthquake forces) of 63,652,000 lb. The resulting stresses in the masonry and on the rock foundation do not differ appreciably from those without earthquake effect

The behavior of the anchorages for earthquake waves at right angles to the longitudinal axis of the bridge has been investigated also, and the resulting stresses were found to be negligible. Because of the somewhat irregular shape of the anchorages, the pressure diagrams without and with earthquake effect considered, which are shown in Figs. 3 and 4, may prove interesting.

The masonry masses of both the piers and the anchorages could be considered as practically rigid. This does not hold for the steel superstructure, which is flexible to a high degree in some of its parts and directions and less in others. Here then, the flexibility had to be given due consideration in each case. Two main directions of earthquake waves were considered as acting on the superstructure, one parallel to the longitudinal axis of the bridge, the other transverse to it.

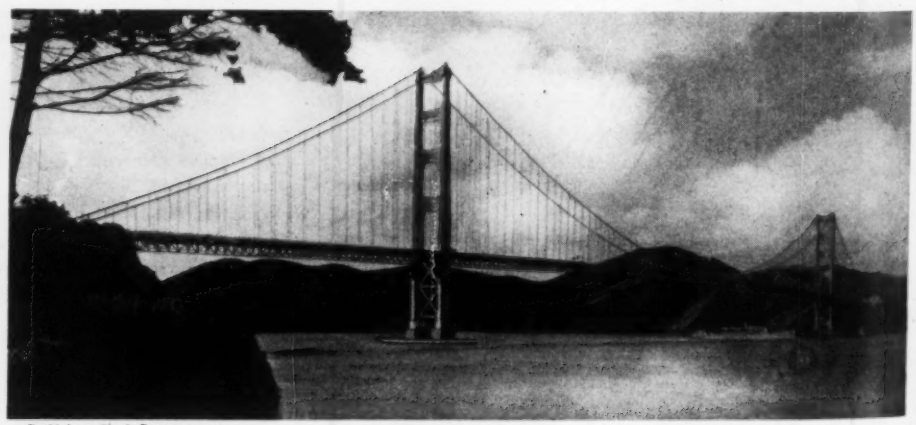
Waves acting parallel to the longitudinal axis will be considered first. In studying their effect it is necessary to take three items into account, namely: (1) increase in cable pull, (2) acceleration of the suspended span, and (3) force due to the weight of the towers themselves.

Cables. A sudden earthquake shock will tend to increase the horizontal cable pull on one side of the tower and to decrease it on the other side. For an earthquake force of 7.5%, this would result in a force of approximately 18,000,000 lb (total for both cables) but this force will never come into action because of the great flexibility of the towers in this direction. Studies indicated that the actual effective force is negligible; all the acceleration is absorbed in the deflection of the towers. (It will be recalled that this was not the case at the anchorages, which have no flexibility to absorb the sudden impulse by deflection.)

Suspended Span. The suspended center span is provided at each end at the towers with expansion joints. It can thus move longitudinally and its weight cannot be accelerated by an earthquake. No forces are therefore produced on the towers by an earthquake acting in a longitudinal direction.

Towers. Studies indicate that the flexibility of the steel towers reduces the initial acceleration to about half. The effect of the earthquake is thus equivalent to a static force of 3.75% of the weight of the tower acting horizontally. The weight of one tower is 44,000,000 lb; the horizontal force therefore is 1,650,000 lb. This force was assumed to act at the mid-height of the tower.

The behavior of the superstructure under earthquake waves acting transversely to the bridge is somewhat different from that resulting from longitudinal waves.



Bethlehem Steel Company

THE GOLDEN GATE BRIDGE

The towers have a far greater transverse stability; in fact, it was assumed in the computations that the deflections did not reduce the acceleration of the earthquake.

Cables. Studies have shown that owing to the low lateral stiffness of the cables, the force exerted by them on the towers and anchorages is very small. It was found to be 38,000 lb acting at the top of the towers, and less than half this value acting on each anchorage.

Suspended Spans. Because of the great length of the suspended spans, only part of this mass is accelerated. The horizontal force acting on each tower due to the acceleration of the suspended spans is computed to be 400,000 lb; one-half of it is caused by the main span and one-half by the side spans.

Towers. As already mentioned, the lateral stiffness was assumed to be so high that the acceleration due to earthquake is extended over the full length of this structure. The full 7.5% of the weight of the tower was therefore assumed. This resulted in a horizontal force of 3,300,000 lb. For further safety, this force was assumed to act at mid-height of the tower.

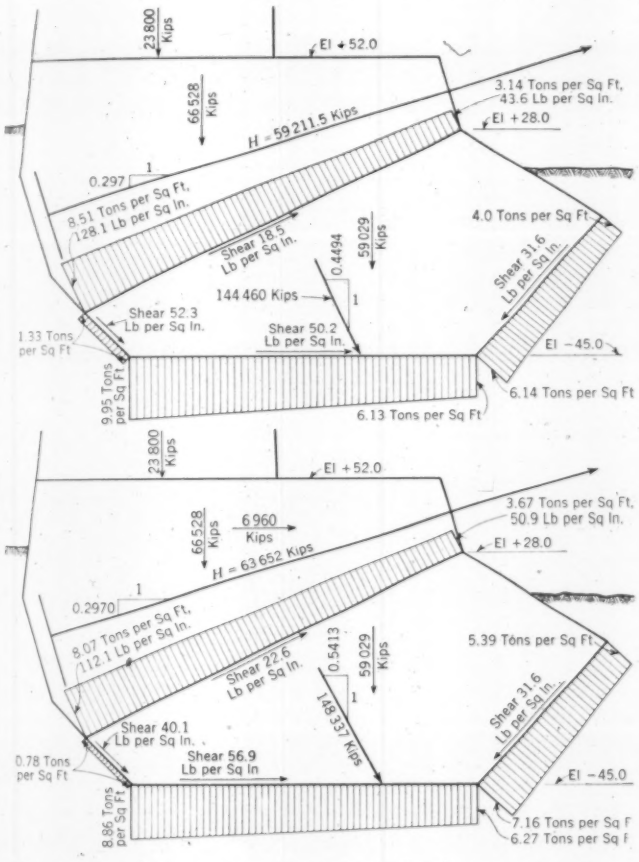

23 800 Kips
El +52.0
66 528 Kips
3.14 Tons per Sq Ft, 43.6 Lb per Sq In.
El +28.0
H = 59 211.5 Kips
0.297
1
8.51 Tons per Sq Ft, 128.1 Lb per Sq In.
Shear 18.5 Lb per Sq In.
59 029 Kips
0.4494
144 460 Kips
4.0 Tons per Sq Ft
Shear 31.6 Lb per Sq In.
Shear 52.3 Lb per Sq In.
Shear 50.2 Lb per Sq In.
1.33 Tons per Sq Ft
El −45.0
9.95 Tons per Sq Ft
6.14 Tons per Sq Ft
6.13 Tons per Sq Ft
23 800 Kips
El +52.0
66 528 Kips
6 960 Kips
3.67 Tons per Sq Ft, 50.9 Lb per Sq In.
El +28.0
H = 63 652 Kips
0.2970
8.07 Tons per Sq Ft, 112.1 Lb per Sq In.
Shear 22.6 Lb per Sq In.
59 029 Kips
0.5413
148 537 Kips
5.39 Tons per Sq Ft
Shear 31.6 Lb per Sq In.
Shear 40.1 Lb per Sq In.
Shear 56.9 Lb per Sq In
0.78 Tons per Sq Ft
El −45.0
8.86 Tons per Sq Ft
7.16 Tons per Sq F
6.27 Tons per Sq F

FIG. 3. DIAGRAMS OF UNIT PRESSURES AND SHEARS IN SAN FRANCISCO ANCHORAGE (WEST SIDE)

Upper Diagram, Not Considering Earthquake Effect; Lower Diagram, Earthquake Effect Included

EARTHQUAKE EFFECTS ON PIERS

The San Francisco pier was built as a unit together with the cofferdam. The base is at El. −100, and the total weight is 558,000,000 lb. Of this weight, 480,000,000 lb is above rock and will exert stresses on the foundations. Ten per cent of this weight was assumed to act at its center of gravity (El. −35). The force, amounting to 48,000,000 lb, is the same for any direction of the earthquake waves. Since the pier is in 80 ft of water, the effect of the water was also included in the stresses. This is equivalent to 9,700,000 lb for waves acting longitudinally and to 5,200,000 lb for waves acting transversely, these forces acting 48 ft below the water level.

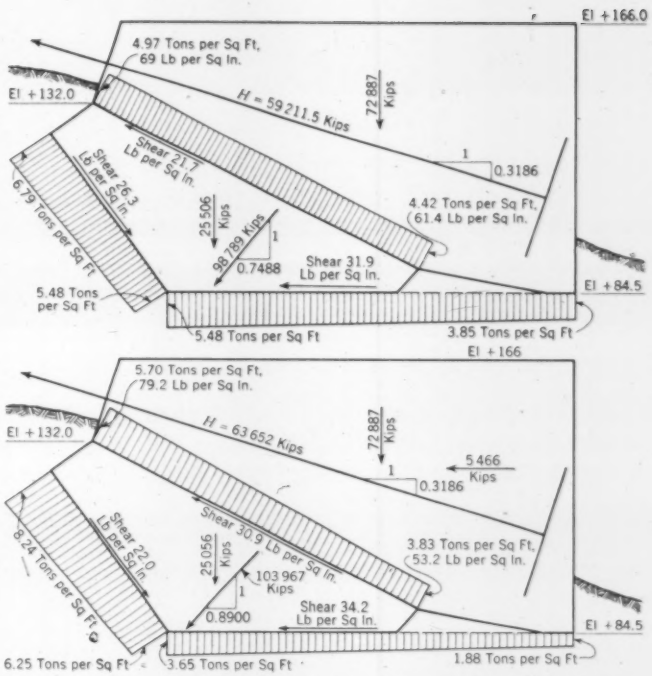

El +166.0
4.97 Tons per Sq Ft, 69 Lb per Sq In.
El +132.0
H = 59 211.5 Kips
72 887 Kips
1
0.3186
Shear 21.7 Lb per Sq In.
Shear 25.3 Lb per Sq In.
6.79 Tons per Sq Ft
25 506 Kips
98 789 Kips
1
0.7488
4.42 Tons per Sq Ft, 61.4 Lb per Sq In.
Shear 31.9 Lb per Sq In.
El +84.5
5.48 Tons per Sq Ft
5.48 Tons per Sq Ft
3.85 Tons per Sq Ft
El +166
5.70 Tons per Sq Ft, 79.2 Lb per Sq In.
El +132.0
H = 63 652 Kips
72 887 Kips
1
5 466 Kips
0.3186
Shear 30.9 Lb per Sq In.
Shear 22.0 Lb per Sq In.
8.24 Tons per Sq Ft
25 056 Kips
103 967 Kips
1
0.8900
3.83 Tons per Sq Ft, 53.2 Lb per Sq In.
Shear 34.2 Lb per Sq In.
El +84.5
6.25 Tons per Sq Ft
3.65 Tons per Sq Ft
1.88 Tons per Sq Ft

FIG. 4. DIAGRAMS OF UNIT PRESSURES AND SHEARS IN MARIN ANCHORAGE (WEST SIDE)

Upper Diagram, Not Considering Earthquake Effect; Lower Diagram, Earthquake Effect Included

For earthquake waves parallel to the longitudinal axis of the bridge, the total horizontal force on the San Francisco pier is 59,400,000 lb and the total moment is 4,320,000,000 ft-lb. The superstructure contributes 3% of the force and 10% of the moment. For waves perpendicular to the longitudinal axis, the total force is 57,000,000 lb, and the moment 5,129,000,000 ft-lb. Here the superstructure contributes 6.5% to the force and 35% to the moment.

The Marin pier is considerably smaller. The base is at El. 20, and the total weight of the pier is 96,000,000 lb, of which 77,000,000 lb was assumed to induce stresses in the structure. This is equivalent to a horizontal force of 7,700,000 lb acting 36 ft above the base.

On the Marin pier, for waves parallel to the longitudinal axis of the bridge, the total horizontal force is 9,350,000 lb and the moment 960,000,000 ft-lb. Of these, 18% and 70% respectively are contributed by the superstructure. For waves perpendicular to the longitudinal axis of the bridge, the horizontal force increases to 11,400,000 lb and the moment to 1,774,000,000 ft-lb. Of these, 33% and 84%, respectively, are caused by the vibrations of the superstructure.

In conclusion it may be pointed out that the effect of earthquake on the deflections and stresses in the superstructure was found to be considerably less than that of a 30-lb wind acting on the bridge. The towers are firmly anchored to the piers, and no danger of movement of the tower bases exists. The effect on the piers and foundations is equally small; increased pressure due to earthquake on the San Francisco pier is 2.5 tons per sq ft, and on the Marin pier, 3 tons per sq ft, while the highest shears are not more than 10 lb per sq in.

Professional Status—A Canadian Viewpoint

"Stature" of Individual Engineer Held to Be the Major Consideration

By C. R. YOUNG

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
PROFESSOR OF CIVIL ENGINEERING, UNIVERSITY OF TORONTO, CANADA

and R. F. LEGGET

ASSOCIATE MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
ASSISTANT PROFESSOR OF CIVIL ENGINEERING, UNIVERSITY OF TORONTO, CANADA

DESPITE the fewness of their numbers, the early engineers of Canada were active in the effort to share in a common advance. The Engineering Institute of Canada, organized in 1887 under a different name, has taken a leading role in this progress. Yet in Canada, as here, much remains to be done in improving the status and economic stability of engineers. In discussing this many-faceted problem, now much to the fore in engineering thinking, two members of the Institute here conclude that the solution lies "to a large extent in the attitude and bearing of the individual engineer himself." The paper of which this article is an abstract was prepared on the special invitation of the Society's Committee on Professional Objectives.

WHILE substantial progress has been made in Canada in impressing upon the public the high character of the services performed by the engineer, there is still a very long way to go before the measure of public appreciation now readily accorded to the other professions will be granted to the engineer as a matter of course.

Alan Macdougall, in a notable paper on professional status, presented to the Canadian Society of Civil Engineers in 1892, concurred in the views of a former president of the Western Society of Engineers that the early engineer of this country was a species of scientific or skilled tramp with a precarious tenure of position, who furnished his employer with the skill of his trade without questioning public policy or the best solution. Speaking some years later, a member of the Society related that his parents had left him some money to study a profession and, on his choosing engineering, certain persons tried to prevent him from getting the money, representing that engineering was not a profession at all. He had to prove the validity of his choice in the courts at great expense and was impressed with the great surprise exhibited when the court decided in his favor.

Undoubtedly the activities of the Engineering Institute of Canada, and its predecessor, the Canadian Society of Civil Engineers, have done much towards remedying the situation complained of a generation ago. On more than one occasion the Society took strong ground where the interests of the engineer were at stake. The Engineering Institute has protested vigorously against the attempts of certain municipalities to obtain engineering services by the device of calling for tenders on a price basis, in some cases involving the submission of competitive plans and specifications free of charge.

On the other hand, the development of a strong cooperative professional spirit has undoubtedly been retarded by the fact that many members of the Institute are employees of large corporations or of governments and work under conditions that frequently make it difficult to take firm ground in asserting the prerogatives commonly associated with a profession.

Despite the occasional instance of an engineer serving in the role of cabinet minister, chairman or member of a utilities board, or member of a royal commission, engineers have played anything but a conspicuous part in the public life of this country. On the general ground that others are responsible for economic and social decisions, technically trained men have remained sadly indifferent to the ultimate results of the technical developments following in the train of their labors.

With existing acts regulating professional engineering in eight of the nine provinces, it must be said that the legal position of the civil engineer in Canada is now fairly secure, at least in theory. No one may describe himself as an engineer, or hold himself out to the public as such, unless he is a registered member of the applicable provincial association or corporation of engineers.

So far, there has not been witnessed that improvement of the economic lot of the engineer in Canada that might have been expected to follow the increasing importance to the public of the services that he performs. While through the work of its Committee on Remuneration the Engineering Institute has set up a basis of fair compensation, conformity to it by employers is not general.

A highly delicate situation exists between the employer-engineer and the employee-engineer. Unfortunately, many of the former, while wishing to raise the general level of compensation for all engineers, are themselves employed by corporations or governments, and salary levels have been fixed by superior authority.

The Canadian Society of Civil Engineers and the Engineering Institute of Canada have each in their time brought to bear influences for the general improvement of the economic status of the engineer. Although these activities have shown an awareness of the economic interests of the engineer, they have not appeared, in some quarters, to be adequate to meet the situation. As a result, the unionization of technically trained men has gained some headway in at least five centers in Canada.

"STATUS," AS SUCH, NOT AIDED BY LEGISLATION

Much has been written concerning the mechanism by which the engineer may improve what has been termed his professional status. Sooner or later he will appreciate the fact that professional status, as such, cannot be aided by legislation. Legal restrictions may improve his economic lot but, no more than unionization, can they enhance his position in the mind of the public.

The simple truth is that the solution lies to a large extent in the attitude and bearing of the individual engineer himself. As has been strikingly put by J. B. Carswell, we should concern ourselves not with the "status," but rather with the "stature" of the engineer. If the response to the desire of the engineer for recog-

nition is to be cordial, he must create in the public mind a vivid appreciation of the high quality and dependability of his services. Very frequently, the duties of the engineer are quasi-judicial in that he adjudicates between the owner and the contractor, while at the same time being in the pay of the former. Despite the anomaly of his position, rarely indeed are there any complaints of unfairness. Acquaintance with this fact, not widely appreciated by the public, is a matter that can be dealt with only by an organization in which the public has confidence.

Corporate action in relation to professional status is also of special value in connection with the delicate situations in which employee-engineers sometimes find themselves. Due to political or economic factors beyond their control, such engineers may be placed in positions that call for corporate professional action in support of the individuals concerned. Some instances of this nature have occurred in Canada, and it is fair to say that a necessary part of the future development of the profession in Canada will be an increase in this form of organized professional activity.

VALUE OF THE "MASTER-NOVICE" RELATIONSHIP

To the end that the younger engineers may without undue delay acquire something of the professional spirit, it may turn out that something akin to the master-novice relationship should be set up by the engineering profession itself for the benefit and guidance of the young graduate engineer. A mechanism calculated to usher the young engineer into the philosophy of the profession early in his career is that provided, for example, by the law administered by the Corporation of Professional Engineers of Quebec. In accordance with this, engineering students in college are regarded as engineers in training of the corporation, and enter into full membership upon graduation. The extension of this training, possibly along the lines of the admirable plan for graduate engineers followed by the Institution of Civil Engineers, is something to which many Canadian engineers look forward hopefully.

An incidental difficulty that militates against a proper public appraisal of the position of the engineer is the current practice in English-speaking circles on this continent to employ the term "engineer" as applicable not only to the professional engineer but to those engaged in the operation, maintenance, and repair of stationary or moving engines. As Canada is a bilingual country, it is of interest to note that French-speaking Canadians are spared this confusion. In Quebec, the home of most French Canadians, the profession is legally represented by the Corporation of Professional Engineers, and the application of the title *ingénieur* is specifically restricted by law to members of this corporation. The term *mecanicien* is employed in French to describe operators, locomotive drivers and others, who claim and use the title "engineer" in those parts of North America where the English language predominates. It is regrettable that, in this connection at least, English-speaking Canadian engineers cannot follow the excellent practice of their professional fellows whose native tongue is that of France.

If the engineering profession is to occupy an important position in national life it must take cognizance of the effect upon the general economy and manner of living of the scientific developments, credit or blame for which lies at the door of the engineer. While there appears to have been a studied reluctance on the part of engineers to express opinions on public questions in this country, it does not appear possible for technical organizations of national scope to maintain for long their prestige and full usefulness without taking into account the most important of all problems—the general welfare of the people.

There is no need for the engineer to make a direct march to public office. If he achieves that measure of distinction which establishes him as an outstanding member of a learned profession, and shows the knowledge and appreciation of public questions that are properly associated with an educated man, the public will very soon realize his acceptability to represent them in difficult and important situations.

ENGINEERS' NOTEBOOK

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

A Graphical Method of Analyzing Eccentrically Loaded Concrete Sections

By PAUL ANDERSEN, ASSOC. M. AM. SOC. C.E.

ASSISTANT PROFESSOR OF STRUCTURAL ENGINEERING, UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MINN.

THIS article presents a graphical method of analyzing the stresses in reinforced concrete sections under direct compression and non-symmetrical bending. The method is based on the usual assumptions of reinforced concrete design, namely, preservation of plane sections, proportionality between stress and strain, and disregard of tensile stresses in concrete.

Basic Theory. In Fig. 1(*a*) are shown two parallel forces of magnitudes P and Q. The neutral point, N, of these two forces is the point from which distances to the two forces are proportional to their magnitudes. The centroid, C, of the two forces is the intersection between the line of action of the resultant and another line through the neutral point perpendicular to their direction.

Referring to Fig. 1(*a*) and (*b*), it will be shown that the neutral point, N, of two parallel forces, P and Q, having a centroid at C coincides with the centroid of the two forces P_1 and Q_1, acting along the same lines but with magnitudes changed to make C the neutral point.

Considering the two forces, P and Q, in Fig. 1(a), it is seen that

$$\frac{P}{a - x} = \frac{Q}{x} \quad \ldots\ldots (1)$$

and

$$Pm = Q(a + m) \quad \ldots\ldots (2)$$

Solving for x, which represents the distance from the force Q to the neutral point N, gives

$$x = \frac{am}{a + 2m} \quad \ldots\ldots (3)$$

Consider next the two forces, P_1 and Q_1, in Fig. 1(b). It is seen that

$$\frac{P_1}{m} = \frac{Q_1}{a + m} \quad \ldots\ldots (4)$$

and

$$P_1(a - x) = Q_1 x \quad \ldots\ldots (5)$$

Solving for x, which now denotes the distance from the force Q_1 to the centroid C_1, gives

$$x = \frac{am}{a + 2m} \quad \ldots\ldots (6)$$

Equations 3 and 6 show that if the centroid of two forces is known, the neutral point can be found as the centroid of two other forces acting along the same lines and of magnitudes corresponding to a neutral point at the original centroid. It is readily seen that this theorem can be extended to include any number of parallel forces with magnitudes varying as straight lines. In other words, the neutral axis of a reinforced concrete section subjected to an eccentric load can be found as the centroid of the internal forces which are proportional to the distances from the point of eccentricity.

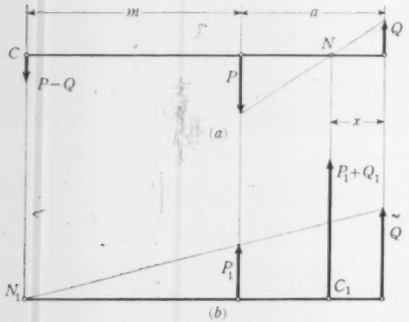
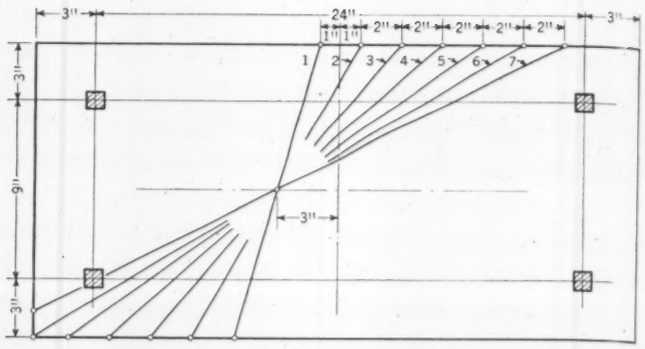


FIG. 1

Direction of Neutral Axis. Consider a square section of a material capable of resisting both tension and compression. If this section is subjected to the influence of a bending moment acting in a plane other than the two principal planes, then the neutral axis will be perpendicular to the plane of bending forces. If it is assumed that the material is incapable of resisting tension, then the neutral axis will no longer remain normal to the plane of bending. As will be shown in the following paragraphs, however, the deviation from a right angle is so slight that no appreciable error is involved in assuming a right-angle position for the neutral axis of a square section.

The position and direction of the neutral axis corresponding to an eccentrically placed load can be found



Reinforcement; Four 1" Square Bars

Case	β	Angle α		Case	β	Angle α	
		Actual	Computed			Actual	Computed
1	3°10′	14°56′	13°35′	5	15°48′	53°08′	49°57′
2	6°19′	28°04′	25°48′	6	18°49′	58°00′	56°54′
3	9°29′	38°40′	35°45′	7	22°05′	61°49′	60°34′
4	12°38′	46°51′	44°24′				

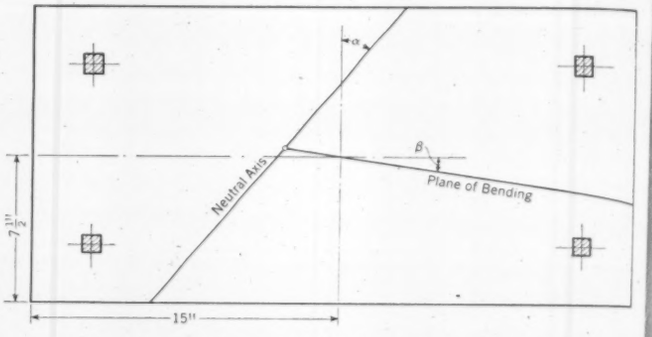


FIG. 3. RELATION BETWEEN NEUTRAL AXIS AND PLANE OF BENDING MOMENT FOR A RECTANGULAR SECTION

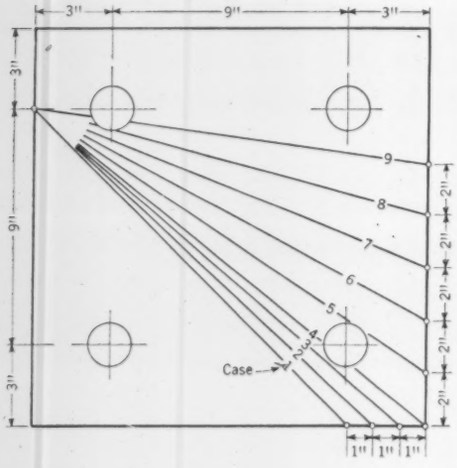
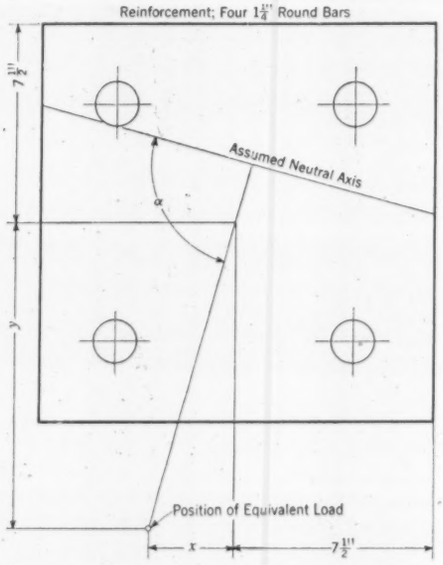


FIG. 2. RELATION BETWEEN NEUTRAL AXIS AND PLANE OF BENDING MOMENT FOR A SQUARE SECTION



Case	x	y	α
1	46.115	46.115	90°00′
2	21.484	23.029	89°42′
3	14.023	16.092	89°32′
4	10.448	12.820	89°28′
5	5.930	8.810	89°44′
6	3.676	6.859	89°53′
7	2.189	5.683	90°44′
8	1.226	4.869	90°48′
9	0.527	4.244	90°33′

from the two equations expressing zero sums of moments about any two lines through the point of eccentricity. These two equations, however, are quite complicated and can be solved only by trial. In order to study the relation between direction of neutral axis and plane of bending moment, it is easier to assume a neutral axis and a

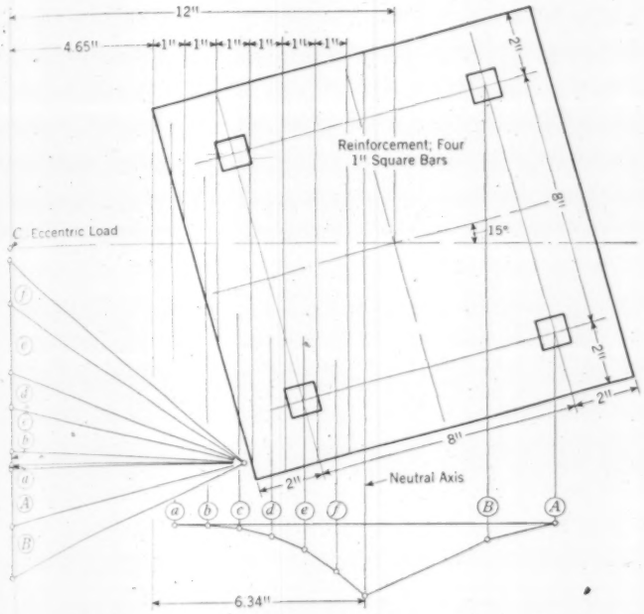


FIG. 4. NUMERICAL EXAMPLE

stress at some point of the section and then determine the corresponding eccentric load by the three requirements of statics—namely, the projection of all vertical forces and the sums of moments about two lines must equate to zero. The first of these equations will contain, as the only unknown, the magnitude of the eccentric load. Coordinates to the point of eccentricity are then determined by the two moment equations.

This method of study is shown in Fig. 2 for a square concrete section reinforced with four corner rods. The ratio of moduli was assumed to be equal to 15, and the maximum compressive stress was taken as unity; other stresses were computed according to their distances from the neutral axes. Nine different positions of the neutral axis are shown, together with equivalent points of eccentricity. For the cases of symmetrical bending and diagonal bending (assumption No. 1) the angle between neutral axis and plane of bending equals, of course, 90°. For the intermediate cases it is seen from the table in Fig. 2 that for all practical purposes the neutral axis for a square concrete section can be assumed normal to the plane of bending.

Consider next a rectangular section subjected to nonsymmetrical bending. In case the member consists of a material having the same properties in tension and compression, the direction of the neutral axis is determined from the relation

$$\tan \alpha = \frac{I_1}{I_2} \tan \beta \qquad (7)$$

where

I_1, I_2 = principal moments of inertia
α = angle between neutral axis and principal plane
β = angle between plane of bending and other principal plane

In Fig. 3 a study is shown for the rectangular section similar to that explained for the square section. Seven different positions were assumed for the neutral axis, equivalent planes of bending determined by the requirements of statics, and the angle, α, was checked by Eq. 7. The agreement, although not as intimate as for the square section, is sufficiently close to warrant the use of Eq. 7 for determining the direction of the neutral axis.

Numerical Example. Figure 4 shows a square reinforced concrete section reinforced with four 1-in. square bars and subjected to the influence of a concentrated load acting at a point C, which is 12 in. from the centroid of the section, and the plane of bending making an angle of 15° with one of the principal axes. The ratio between the moduli is assumed to be 10.

The section is divided into strips 1 in. wide and normal to the plane of bending. The equivalent forces for the compression area are designated a, b, c, d, e, and f. The magnitudes of these forces are:

$$(a)\ \frac{5.15}{4.65} \times 2 = 2.21$$

$$(b)\ \frac{6.15}{4.65} \times 6 = 7.93$$

$$(c)\ \frac{7.15}{4.65} \times 10 + \frac{7.10}{4.65} \times (10\text{–}1) = 29.1$$

$$(d)\ \frac{8.15}{4.65} \times 12.40 = 21.73$$

$$(e)\ \frac{9.15}{4.65} \times 12.42 + \frac{9.17}{4.65} \times (10\text{–}1) = 42.19$$

$$(f)\ \frac{10.15}{4.65} \times 12.42 = 27.11$$

The equivalent forces from the tension area are designated A and B, they equal

$$(A)\ \frac{16.90}{4.65} \times 10 = 36.33 \qquad (B)\ \frac{14.90}{4.65} \times 10 = 32.03$$

A string polygon for the equivalent forces is drawn, starting at both ends and including as many forces as necessary before intersection is obtained. The point of intersection locates the neutral axis.

If the magnitude of the eccentric load is known, then the maximum compressive stress in the concrete is readily found by equating this magnitude to the difference between internal compression and tension stresses. Thus if the magnitude of the load at C is equal to 10,000 lb,

$$(a)\ f \times \frac{5.84}{6.34} \times 2 = 1.842 f$$

$$(b)\ f \times \frac{4.84}{6.34} \times 6 = 4.580$$

$$(c)\ f \times \frac{3.84}{6.34} \times 10 + \frac{3.89}{6.84} \times 9 = 11.579$$

$$(d)\ f \times \frac{2.84}{6.34} \times 12.40 = 5.555$$

$$(e)\ f \times \frac{1.84}{6.34} \times 12.40 + \frac{1.82}{6.84} \times 9 = 6.188$$

$$(f)\ f \times \frac{0.84}{6.34} \times 12.42 = 1.646$$

$$(A)\ f \times \frac{5.91}{6.34} \times 10 = -9.322$$

$$(B)\ f \times \frac{3.91}{6.34} \times 10 = -6.167$$

$$15.901 f = 10{,}000$$

The maximum stress in the concrete is therefore $f = 10{,}000 \div 15.9 = 628$ lb per sq in. The maximum tensile stress in the reinforcement is

$$f_s = \frac{5.91}{6.34} \times 10 \times 628 = 5{,}854 \text{ lb per sq in.}$$

Use of Relief Pipes to Reduce Thickness of Concrete Seal

By H. V. McCOY, M. AM. SOC. C.E.

ASSISTANT DISTRICT CONSTRUCTION ENGINEER, ILLINOIS DIVISION OF HIGHWAYS, EAST ST. LOUIS, ILL.

AN interesting construction expedient that reduced considerably the required thickness of the concrete seal beneath a structure in water-bearing soil is described in this article. The building involved was a pump house, on a grade separation project of the Illinois state highway system in East St. Louis, Ill.

The elevation of the bottom of the pump-house footing is 142.0. The material encountered was a finely divided sand with varying amounts of decayed vegetable matter which considerably reduced the specific gravity of the mass, as well as acted to some extent as a lubricant for the sand particles. The material was water bearing, the ground-water level being at El. 162.0.

The contractor drove steel sheet piling to form a cofferdam 20 ft wide by 44 ft long. After he had excavated inside it to approximately El. 150.0, the amount of water coming in through the material in the bottom was so great that a system of 47 well points, $1\frac{1}{4}$ in. in diameter, had to be installed. With a 6-in. pump connected to the well points and another 6-in. pump operating inside the cofferdam, he was able to keep the water down sufficiently to complete his excavation to approximately El. 142.0, that is, to the bottom of the concrete of the pump house. The material encountered at this elevation was very soft, but by shoving a board into it the material at El. 140.0 was found to be much firmer sand and much more suitable for the foundation. The large amount of water coming through the material in the bottom, however, indicated that it would be necessary to pour a heavy seal coat to insure that the concrete placed for the footing would be waterproof. This was necessary in both the wet and dry pits of the structure.

Calculations showed that a 6 or 7-ft thickness of seal would be needed to balance the approximate 22-ft head of water outside the cofferdam. If we could reduce the pressure caused by this head, however, we could reduce the thickness of the seal. With this object in mind, it was decided to install a system of relief pipes before the seal coat was placed. From the operation of the well-point system it appeared that 27 pipes, each having a diameter of $1\frac{1}{4}$ in., would be required. With this installation it was believed that the pressures on the bottom of the seal when the cofferdam should be dewatered would be lowered to such a point that a seal 2 ft thick would be sufficient.

The 2 ft of additional excavation necessary for the seal was made under water, the cofferdam being allowed to fill before it was begun.

Next the relief pipes were installed. As shown in Fig. 1, there were three rows of nine pipes each, spaced so that the two outside rows were outside the neat lines of the pump house and the middle row was at the center line.

TABLE I. FLOW OBSERVATIONS ON RELIEF PIPES

PIPE NO.	EL. OF GROUND WATER	DISCHARGE, GAL. PER MIN.	EL. OF BOTTOM OF SEAL COAT	EL. OF WATER IN STAND PIPE	HEAD THIS PIPE CLOSED, ALL OTHERS RUNNING
1	162.0	2.72	144.13	154.60	10.47
2	162.0	2.48	144.13	154.25	10.12
3	162.0	2.50	144.13	154.49	10.36
4	162.0	4.25	142.80	154.72	11.92
5	162.0	2.75	142.80	153.77	11.97
6	162.0	3.75	142.80	153.89	11.09
7	162.0	3.33	141.47	154.48	13.01
8	162.0	3.20	141.47	154.01	12.54
9	162.0	3.75	141.47	154.00	12.53
10	162.0	5.08	140.00	154.03	14.03
11	162.0	3.90	140.00	153.41	13.41
12	162.0	4.42	140.00	154.59	14.59
13	162.0	5.00	140.00	153.52	13.52
14	162.0	5.56	140.00	153.50	13.50
15	162.0	5.18	140.00	154.36	14.36
16	162.0	3.33	140.00	153.59	13.59
17	162.0	5.18	140.00	153.34	13.34
18	162.0	6.67	140.00	154.24	14.24
19	162.0	6.13	140.00	154.42	14.42
20	162.0	5.18	140.00	153.43	13.43
21	162.0	6.38	140.00	153.92	13.92
22	162.0	7.15	140.00	154.46	14.46
23	162.0	5.36	140.00	153.67	13.67
24	162.0	5.18	140.00	153.92	13.92
25	162.0	5.12	140.00	153.82	13.82
26	162.0	8.82	140.00	153.92	13.92
27	162.0	5.27	140.00	154.51	14.51
		127.60			

Each pipe terminated in a 2-ft section of well point, to prevent the fine sand from flowing out with the water, and extended 4 ft below the bottom of the proposed seal. The 2-ft seal was then placed, under water, over the full area of the cofferdam, and allowed to set.

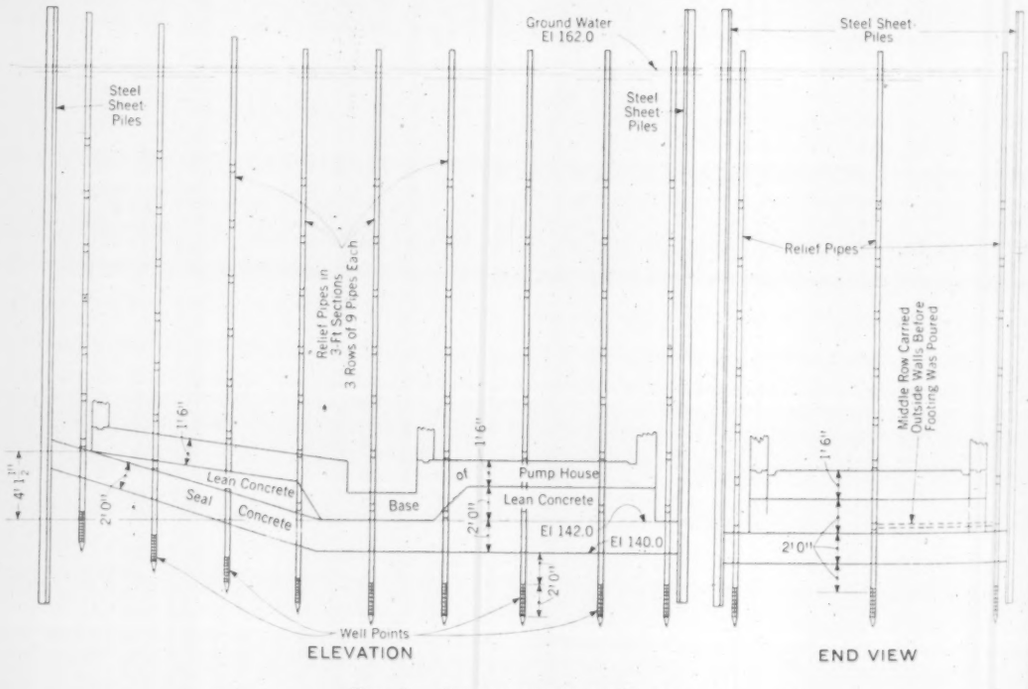
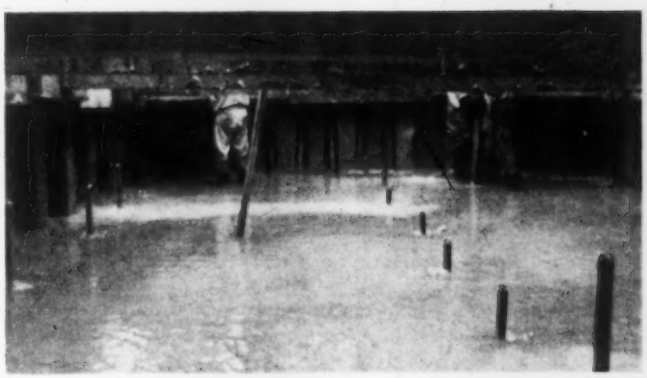


FIG. 1. ARRANGEMENT OF PIPES

Six days later, dewatering was begun. When the water surface was lowered below the first joints of pipe, the top sections were removed. Immediately water started to flow from all pipes—very slowly, but sufficiently to indicate that they were functioning satisfactorily. As the water was lowered still further and as additional sections were removed, the flow increased.

When the cofferdam had been practically dewatered and the sections of pipe above the seal coat had all been removed, measurements were taken of the flow from the various pipes as shown in Table I. It will be noted that this flow totaled 7,656 gal per hour. In the fifth column of the table are a series of elevations called "elevation of water in stand pipe." Each of these elevations was obtained by placing a straight section of pipe back on a particular pipe and measuring the height to which the water rose in it while all other relief pipes were flowing. This, of course, was only a measurement of the pressure that would exist on the bottom of the seal at that point if no relief pipe had been installed there. No doubt the actual pressure at any point with all relief pipes functioning was considerably lower than this indicated head. Considerable variation in the flow and in the static head on the individual pipes is to be noted. This is probably due to variations of the material at different points beneath the seal, and to the fact that the openings into the well points were more free in some cases than in others.

After the cofferdam had been completely dewatered by pumping from a sump in one corner, the seven pipes that were to be beneath the pump house were carried outside the limits of the pump house pits by placing elbows and extensions on them, as indicated in Fig. 1. All pipes were then allowed to continue to flow and the water was carried to the sump, from which it was pumped outside the cofferdam. A course of "lean concrete" was then poured which conformed to the bottom of the pump-house footing, and the footing and walls of the pump house were poured in the dry. The cofferdam was kept dry by pumping from the sump until the concrete in the pump-house walls had obtained sufficient strength, when the water was allowed to rise to its original elevation of 162.0 outside the walls of the pump house.



COFFERDAM NEARLY DEWATERED; RELIEF PIPES FLOWING

The method recounted here was entirely successful, and it would appear that its application in many other cases might effect a considerable saving in the thickness of seal required.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Highway Problems

TO THE EDITOR: Much has been written and said about highway "subsidies" and the "diversion" of motor vehicle taxes to other than highway uses. But such discussions are usually either academic or propaganda, because the opinions or answers developed in any study depend entirely on the assumptions made; and one commission rather intimated that the assumptions selected seem to vary according to the particular interest having the study made. Transportation—rail, highway, water, and air—is, after popular education, the most vital necessity of our modern civilization, and the public will not tolerate the restriction or the handicapping of any of these facilities.

As to types of highway construction: It is generally agreed that poor foundations have been responsible for most highway surface troubles. But engineers are working on soil stabilization, and it seems likely that a technique will be developed whereby highway foundations equal to those of the Roman military roads of 2,000 years ago can be economically built almost anywhere. So the highways of the future may consist of a stabilized foundation covered—except where the heaviest traffic is to be carried—with only a thin flexible mat to protect it from wear and weather.

It is also possible we are emphasizing too much the need for heavy expenditures on alinement and grades. Probably not one man in a hundred is physically and temperamentally fitted to drive in traffic at 50 miles per hour, and long straight stretches of low gradient highway, in addition to being monotonous, are a temptation for the lunatic amateur to attempt speeds of 70 or 80 miles per hour.

As to highway routes: In outlying suburban and rural districts this problem is not difficult. But in our large cities it seems almost hopeless. Conditions can be somewhat bettered by substituting organized public utility transport for much of the city traffic, by handling much of the trucking at night, by severely restricting parking, by closing many street crossings, and in other ways. It will be for each city to decide whether it will submit to such restrictions or be gradually choked by its own traffic.

The Public Roads Administration has advised against toll superhighways, so the Pennsylvania Turnpike will be watched with interest. Its fate will presumably be decided by the commercial traffic it attracts, as pleasure cars are hardly likely to use such a race track extensively. At present it begins nowhere and ends nowhere, merely duplicating with a 160-mile cutoff over the mountains the line haul of the railroads for which they are preeminently fitted. So it is difficult to see its economic justification in view of the capacity of the railroads to handle fast freight in this territory. The difficult freight problems of railroad transportation have always been in the terminal areas rather than in the line haul, and the turnpike traffic may make this terminal problem worse by transferring some of the private siding freight to the congested streets.

It would seem that what is most needed in our whole highway program is some of the intensely commercial spirit which has been responsible for the phenomenal success of the motor vehicle manufacturers.

W. L. WATERS, M. Am. Soc. C.E.
Consulting Engineer
New York, N.Y.

Adapting Engineering Curricula to Future Requirements

TO THE EDITOR: I think you deserve great commendation for the articles appearing monthly under the heading, "Something to Think About." The article entitled "Naught But the Best" in the December number deserves careful reading, not only by all younger engineers but by those in charge of engineering education.

If one carefully reads the reports of investigations conducted by the Society for the Promotion of Engineering Education, he will come to the eventual conclusion that we have before us an enormously difficult task to fit our engineering curricula to our democratic system. I am one of those who believe in the democratic system and a general undergraduate engineering curriculum adapted to it, giving the young man a broad opportunity to develop in any of the many fields leading therefrom. Neither he nor we know what the progress of civilization will demand of him. With his limited knowledge of future requirements, how can he be competent to lay out a course of study for himself?

I also believe that the question of research in undergraduate curricula has been overemphasized. Having done some such work in industry, I am cognizant of its value. However, I am indeed glad that this article by the late Thaddeus Merriman cautions against the unquestioned acceptance of such conclusions.

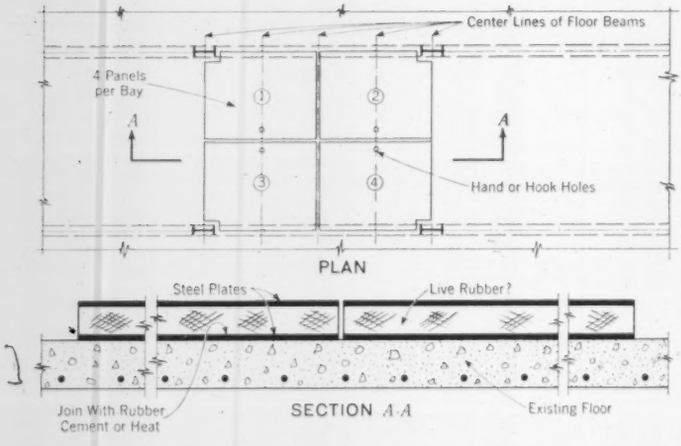
CARROLL D. BILLMYER, Assoc. M. Am. Soc. C.E.
Assistant Professor of Mechanical Engineering
Rhode Island State College

Kingston, R.I.

Air Raid Protection for Industrial and Office Buildings

DEAR SIR: It was with special interest that I read the article by Major Quentin on air raid precautions, in the October issue. The sketch of the proposed shelters in a framed warehouse building made me realize how inadequately industrial and office buildings can be protected with the thought of "business as usual" after a successful air raid.

It occurred to me that secondary precautions would be necessary to protect some of the more essential units of production in industrial buildings after the prime necessity of protecting the workers had been arranged for. I had in mind, particularly, an auxiliary system of flooring—a composite steel plate and rubber section—which could be laid in sections and installed temporarily. This suggestion is shown in the accompanying sketch.



PROPOSED SYSTEM OF AUXILIARY FLOORING (OR WALL PROTECTION)

While this might encroach on the factor of safety of closely estimated existing floors, it should prove a more adequate protection against the bursting effect of explosives because of toughness and resiliency. In addition, it would tend to lessen the destructive effect of falling debris within a building that has been hit. At least, it might be tried where space limitations prevent greater bulk.

I realize that this may not be a novel idea by any means, but it might be the forerunner of an effective method of temporary protection.

WILLIAM GIDLOW, Jun. Am. Soc. C.E.

Lewiston, N.Y.

Sanitary Fill Method

TO THE EDITOR: In the October issue John J. Casey, M. Am. Soc. C.E., presents the history and describes the functioning of the sanitary fill method of disposal of the mixed municipal refuse of San Francisco.

The sanitary fill method of disposal of mixed refuse is undeniably the cheapest and most logical means of disposal where local conditions permit its use. The required factors are available land within an economic hauling distance, suitable isolation, and sufficient cover material obtainable from the refuse or from the vicinity. When mosquito-infested swamp lands can be so employed, the disposal of refuse thereon will accomplish the disposal of an intrinsically obnoxious refuse, the conversion of waste lands into usable areas, and the elimination of mosquito breeding.

With respect to the disposal of any waste such as garbage, sewage, and the like, a department of health is concerned with at least four important matters: (1) rodents, (2) flies, (3) odors, and (4) water supplies. The order and degree of importance of these factors will obviously vary with the locality. In every community it is of paramount importance that rodents be eliminated. Flies are a recognized health hazard everywhere. Odors must not be allowed to occur or, if they do, the isolation must be such that they will not reach inhabited areas. Water supplies must not be injured by drainage from deposits of these organic materials.

Under the provisions of the charter of the city and county of San Francisco, the approval of the Department of Public Health must be secured before any scheme of refuse disposal can be adopted. The department was greatly in favor of the sanitary fill method, if the undertaking would guarantee the fulfillment of the fundamental requirements that have just been mentioned. It became necessary for the department to lay down certain rules under which the procedure of disposal could be conducted innocuously.

The proposed site was exceptionally favorable. It was not related to any water supply. The area was well isolated and in territory devoted to industry. Furthermore, the prevailing winds are offshore—that is, away from the San Francisco peninsula and toward San Francisco Bay, which is several miles wide at this point. Therefore the main problem was rodents and flies. Experience elsewhere had demonstrated that rat and fly infestation could be obviated if each day's contribution of refuse were suitably compacted, leveled, and completely covered with not less than 6 in. of clean, dry earth or similar material. Because of the extraordinary variation in conditions and materials inherent in such an undertaking as the disposal of mixed refuse by the sanitary fill method, the department prescribed a depth of cover of 2 ft of suitable soil over the entire area of each day's deposit. While this depth would be excessive if it were consistently carried out, it has provided a factor of safety and an ideal goal to be striven for.

At various times in the past the Department of Public Health has been called upon to approve proposed methods of refuse disposal, which have involved elaborate salvaging operations and the ultimate utilization of the end products for fertilizer, or for paper, wall board, and the like. The department has disapproved all such schemes on the grounds that the sorting and salvaging of refuse is distasteful and almost impossible of rendering into a sanitary operation, and that the basic requirements of sanitation are apt to be overlooked in the excitement of attempting to operate at a profit.

The operation of the San Francisco sanitary fill has been successful. The ramp in the city and the fill itself are well policed and free from rat infestation and fly breeding. The cost of operation is very low in comparison with other procedures, particularly incineration.

J. C. GEIGER

Director of the Department of Public Health,
City and County of San Francisco

San Francisco, Calif.

The Engineer in Public Service

TO THE EDITOR: I do not find myself in agreement with Mr. Consoer's letter on "The Professional Status of Civil Engineers" in the November issue.

Mr. Consoer speaks of reversing the "trend of the last few decades," and returning "to the offices of practicing and consulting engineers much of the work now done by the salaried engineering staffs of industries and governmental units." My observation is that the engineer stands far higher in public esteem these days than he did forty to fifty years ago. There is a much wider recognition of the need for high class design and supervision of public work. There is a much more general recognition of the necessity for calling in a board of consulting engineers if the city has a major undertaking on hand. The railroad or utility corporation is much more willing to engage a specialist for consultation or to take charge of the direction of certain important and unusual work than was the case half a century ago.

If only the engineers in private practice are to be considered as "professional" and as constituting the "pitifully small group" then we are going to rule out the thousands of high class engineers engaged in the public service, in railroad engineering, or in corporate employment as well as all employee engineers in subordinate jobs. These men have done much of the most magnificent engineering design and construction of all time.

It is unthinkable that such jobs as great water works, sewage plants, bridges, and other major enterprises of our great cities should be turned over to a firm in private practice to build, instead of being the sole problem of an equally qualified staff of city employees, just as unthinkable as that such work should be done without the advice of consultants who are eminent specialists in that field.

The young engineer just out of college must of necessity go into an employee position. He is, for the first few years, getting a post-graduate training in the practical application of theory to practice—that is, experience. If he gets into a good organization with plenty of work his job is just as secure and his advancement just as rapid with the municipal or private corporation as with the private engineering firm.

This is no time to quibble about the word "professional." The lawyer who is on the payroll of a great corporation as a member of the legal staff is a lawyer still—a professional man, bound by the ethics and rules of his profession.

The same is true of the hundreds of medical graduates who are on the staffs of great hospitals and clinics or otherwise on payrolls.

The interest of engineers should be primarily in the young men. Are we paying adequate salaries for service? Are we providing for promotion as advancement is merited? Are we giving them the opportunity to gain experience and specialized knowledge that will insure them permanent positions and permit the few who are qualified in every way to step into future consulting work?

The next interest is recognition of the profession and of the need for adequate engineering service. This calls for publicity of professional matters and for work with states and cities to see that proper classifications, pay, and civil service rules are adopted and enforced and that qualified engineers are put in charge. These things call for the fullest cooperation between all engineering societies—local, state, and national.

Finally we civil engineers must recognize that more and more our work is in the public service as officers or employees of city, state, or nation. I for one cannot agree with the suggestion that such service is not professional service.

HENRY E. RIGGS, Past-President Am. Soc. C.E.
Ann Arbor, Mich.

Engineering in Another Day

TO THE EDITOR: Professor Rayner's articles, in the October and November issues of CIVIL ENGINEERING, remind me of a story that may be interesting.

A relative of mine, Henry Purdon Bell, M. Am. Soc. C.E., in his early experience was employed on some irrigation canal surveys in Spain. He told of the Spanish land surveyor, who did his measuring with a pair of compasses that spread about 6 ft. The surveyor would step these over the ground, sometimes hitting a rock and slipping a foot or so, but that did not seem to matter.

Incidentally, Mr. Bell was born in Belfast, Ireland, and as was the custom, was apprenticed for five years to a prominent civil engineer, Sir Charles Lanyon, for whom he worked on railway surveys and construction at a nominal salary and paid Sir Charles £500 (about $2,500) for the privilege.

CHARLES D. PURDON, M. Am. Soc. C.E.
Paris, Tex.

Bill Provides Employment for Engineers in Private Practice on Federal Work

DEAR SIR: I would like to comment on Mr. Consoer's letter in the November issue. It goes to the heart of "The Professional Status of Civil Engineers."

The heads of government bureaus in Washington have repeatedly complained to the writer that they have no authority under the appropriation acts to employ the services of men in private practice, either engineers or architects. They have repeatedly advised the writer that they cannot accept alternate designs to be bid upon in competition with their own bureau designs. They have advised that the only way they can consider alternate designs is after the contracts are let. Every informed engineer knows that if a contractor substitutes an alternate design for the one called for in the plans he is taking risks which he will not take.

Congressman John G. Alexander of Minnesota has introduced a bill in Congress known as H.R. 7568, which is designed to correct this condition by giving the authority to all government bureaus to employ outside engineering and architectural service or to authorize the preparation of one set of alternate plans and specifications for any of the larger projects. It should be emphasized that this bill simply gives the authority. It is not mandatory and, for reasons which need not be gone into here, cannot be mandatory.

In introducing this bill Mr. Alexander said "I am pleased to present to the members of Congress and to the entire citizenry of this nation a sound and constructive suggestion for real tax reduction without a sting or a flaw." It does not seem to this writer that there can be any valid objection to giving this authority to the bureaus of the government. It should be noted that one effect of this bill, assuming that it is acted upon, will be to increase employment of engineers. When alternate plans are made for the same project, it means that more engineers will participate in the work. With a little competition to stimulate them to their best efforts it should have a salutary effect upon the engineers in government employ as well as upon those in private practice. It should put them on their toes and make them do what engineers are supposed to do—namely, get the desired results for the least cost.

An abstract of the bill follows:

"Be it enacted. . . That for the purpose of reducing the cost of government buildings and other structures and of stimulating interest in efficient designs, plans, and specifications, any department or bureau having charge of building same is hereby authorized to employ competent professional engineers and architects engaged in private practice to prepare [or to assist in preparing] designs, plans, and/or specifications for new buildings and other structures. . .

"The said department or bureau is hereby further authorized to employ competent professional engineers and architects engaged in private practice to prepare alternate designs. . . for new buildings or other structures which are estimated to cost $200,000 each, or more." In such cases the government agency may pay the out-of-pocket cost of preparing the alternate design, including only labor, material, supplies, general office overhead expense, and travel, but not including compensation for or salaries of principals. The alternate designs shall be advertised and submitted for bids at the same time as the designs prepared by the department staff.

"If the low bid. . . on the alternate design. . . show a gross saving to the government equal to or greater than twice the amount of the full fee or fees of the private engineers and/or architects who prepared them and including their out-of-pocket costs, the government shall pay them the said full fee or fees, otherwise not more than the amount of their out-of-pocket costs as hereinbefore defined. . ."

Mr. Alexander expects his bill will come before the Committee on Appropriations in the House in January.

WALTER HALL WHEELER, M. Am. Soc. C.E.
Minneapolis, Minn. *Consulting Engineer*

Salary or Consultant's Fee

TO THE EDITOR: I was interested in Mr. Mitsch's article entitled "Status—Why Not?" in the October number. He thinks the engineer is "Too efficient for his own good." While I think the importance of efficiency is sometimes overestimated, I do not believe the consulting engineer in the hypothetical case cited by Mr. Mitsch would get very far by attempting to stretch the planning and execution of a project over twice the time necessary in order to keep a few less engineers employed twice as long.

The person or organization supplying the finances for such a project usually wishes it completed in a reasonably short time, so the structure can be put into service. Naturally the engineers designing and supervising the job and the contractor and his force constructing it are means to the end and not the end.

This is the type of situation the civil engineer in private practice is up against, and I fail to see how the young engineer working for such a private engineering firm can expect to be continuously employed. It is the nature of the business that the civil engineer on many kinds of projects "works himself out of a job" by finishing a structure.

Improving the status of the engineer should, and probably will, be accomplished gradually by a process of evolution. We ought to do all we can towards that end, but should we necessarily emulate the medical and legal professions? We are different in many ways, some of which Mr. Mitsch has pointed out. A large percentage of engineers have to work for salaries instead of clients' fees, and I venture to guess that this percentage is on the increase and probably will continue to increase indefinitely. The majority of civil engineers in private practice have passed through the salary stage either with some engineering firm, some private corporation, or some government agency.

The young doctor or lawyer very commonly starts out for himself. How would your mature consulting engineers like the competition of recent graduates in the field of private practice, and how much of such practice would the young engineers get, especially on the basis of the same fees charged by both types? The business or profession of engineering absolutely requires that the great majority of engineers, mature as well as young, work for salaries.

Some of the corporations that are managed by men trained as engineers treat their engineers with more consideration than other organizations. Perhaps influential engineering organizations, such as the Society, could accomplish something by attempting to influence such corporation officials in the way of salary increases for their company engineers. Do all of our consulting civil engineers always pay young engineers in their employ, salaries commensurate with the value of their services, taking into account the expenses incurred in gaining their technical education?

I do not like the idea of applying labor-union methods to the engineering profession, but there is some force to the argument that it is about the only way to get results in salary increases.

In the matter of steady employment for engineers probably some of the state highway departments come close to the ideal of a fairly constant force, continuously employed. This is due to the continued demand of the public for increased mileage of improved roads and greater safety for auto traffic. The fact that the planning of highway projects in such states is largely in the hands of engineers tends to promote efficiency and sensible continuity of development.

I think the prominence of highway projects and of large structures like the San Francisco Bay bridges, Hoover Dam, and Grand Coulee help to educate the public to the importance of the engineer and to increase respect for him.

I presume the main reason why engineers frequently think of the medical and legal professions as professional patterns, is that their incomes are supposed to be much larger in proportion to the value of their services than is the case with engineers. As to professional ethics, thinking in terms of dictionary definitions of ethics, I believe the average engineer will compare favorably with the average doctor or lawyer.

Two other callings commonly considered as professions are theology and teaching, so the engineer who has to work for a salary has plenty of fairly respectable professional company in the salary class.

H. P. BOARDMAN, M. Am. Soc. C.E.
Emeritus Professor of Civil Engineering, University of Nevada
Reno, Nev.

Solving the Railway Problem

TO THE EDITOR: In an article appearing in the October issue W. J. Wilgus, Hon. M. Am. Soc. C.E., recites what he thinks are the conditions confronting the railroads and suggests what he fears may be the only remedy—government ownership.

Like many others, Colonel Wilgus apparently considers this so-called railway problem susceptible of solution by scientific treatment. Accordingly, he collects a considerable amount of statistical and other data and then undertakes to support his conclusions in a manner usually employed by those who, by training and experience, are accustomed to rely upon logical thinking and honesty of purpose to find the right answers, on the theory that a scientific problem should be subjected to scientific treatment.

Colonel Wilgus is in error. He is firing in the wrong direction and completely misses the target. The railway problem is not a scientific problem—it is a political problem, and however much they may dislike it, the railroads are badly enmeshed in the practical application of politics, legalistic and otherwise.

It is true, of course, that railroading and railway planning are, in themselves, essentially a scientific process, and it is equally true that politics and science cannot live together. When politics comes in the door, science goes out the window. Either the politician must learn the language of the scientist—and there seems to be a general belief that he cannot do this—or the railroads and their harassed managements must learn the language and methods of practical politics, of which they are quite ignorant, irrespective of popular notions to the contrary.

That the railway situation is in a most unhealthy state and is being made to work more or less insidiously against the interests of the American people seems to be quite generally conceded. In many quarters there is a steadily growing belief that a suitable solution, which would remedy the situation and be made to operate alike in the interests of the general public, the investing public, and the railroads, can ultimately be worked out. It is also believed that this result can be accomplished without recourse to any such "desperate remedy" (government ownership) as that suggested by Colonel Wilgus.

To accomplish this, however, it seems equally certain that ways and means must be found in the first instance for what might be termed "a change in the attitude of approach," in which more courage and more common sense can be substituted for fewer theories and less defeatism.

Perhaps the public and the railroads could best be served by making some practical application of methods, such as those suggested, I believe, by the late Theodore Roosevelt—"If you don't like the game, don't throw down the cards, but change the dealer." Changes in dealers, as well as doctors, usually bring about rather definite changes in policies and practice. In this case, for example, by the substitution of less time and wasted effort spent on analysis—academic or otherwise—and on statistical applications, which few read and still fewer understand, for more courageous, common sense applications, supported by the determination to accomplish the desired results, considerable progress will be made in returning the railroads to their former place as the greatest and most important agency of stabilized prosperity. Something of the kind appears rather necessary, if only as a first preliminary in getting the railroads out of the industrial dog house. Perhaps a real start could profitably be made if a consistent study were made of ways, methods, and applications of our railway labor organizations and certain other pressure groups who deal with matters which vitally affect transportation and who, as events prove, usually seem to know their way around and most of the answers as well.

While agreeing with Colonel Wilgus that some more definitely effective applications are highly desirable and, in some instances, quite necessary, I believe that "a major operation," or the adoption of "desperate remedies" are equally unnecessary—prairie fires are not fought that way.

ROBERT H. FORD, M. Am. Soc. C.E.
Chief Engineer, Chicago, Rock Island and Pacific Railway Company
Chicago, Ill.

Eighty-Seventh Annual Meeting

New York, N.Y., January 17–20, 1940

Program of Sessions, Entertainment, and Trips

Business Meeting, Conferring of Honorary Membership, and Presentation of Prize Awards

WEDNESDAY—January 17, 1940—Morning

Auditorium

9:00 **Registration**

10:00 **Eighty-Seventh Annual Meeting called to order by**

D. H. SAWYER, *President, American Society of Civil Engineers; Chief, Real Estate Section, Public Buildings Administration*, Washington, D.C.

Report of the Board of Direction

Report of the Secretary

Report of the Treasurer

10:30 **Conferring of Honorary Membership**

H. S. CROCKER, *Past-President, Am. Soc. C.E., Consulting Engineer*, Denver, Colo.

Colonel Crocker will be presented to the President by J. P. H. PERRY, *M. Am. Soc. C.E., Vice-President, Turner Construction Company*, New York, N.Y.

J. M. R. FAIRBAIRN, *M. Am. Soc. C.E.*, Montreal, Que., Canada.

Mr. Fairbairn will be presented to the President by J. B. CHALLIES, *M. Am. Soc. C.E., Assistant General Manager, Shawinigan Water and Power Company, Ltd.*, Montreal, Que., Canada.

HENRY S. JACOBY, *M. Am. Soc. C.E., Professor Emeritus, Bridge Engineering, Cornell University*, Washington, D.C.

Professor Jacoby will be presented to the President by R. P. DAVIS, *Vice-President, Am. Soc. C.E., Dean, College of Engineering, West Virginia University; Consulting Bridge Engineer, West Virginia State Road Commission*, Morgantown, W.Va.

T. U. TAYLOR, *M. Am. Soc. C.E., Emeritus Dean of Engineering, University of Texas*, Austin, Tex.

Dean Taylor will be presented to the President by DANIEL W. MEAD, *Past-President, Am. Soc. C.E., Professor Emeritus, Hydraulic and Sanitary Engineering, University of Wisconsin; Consulting Engineer*, Madison, Wis.

11:00 **Presentation of Society Medals and Prizes**

The Norman Medal to CHARLES H. LEE, *M. Am. Soc. C.E., Consulting Engineer*, San Francisco, Calif., for Paper No. 1980, "Selection of Materials for Rolled-Fill Earth Dams."

The J. James R. Croes Medal to C. A. MOCKMORE, *M. Am. Soc. C.E., Professor and Head, Department of Civil Engineering, Oregon State College*, Corvallis, Ore., for Paper No. 1990, "Flow Characteristics in Elbow Draft-Tubes."

The James Laurie Prize to STANLEY M. DORE, *M. Am. Soc. C.E., Assistant Chief Engineer, Metropolitan District Water Supply Commission of Massachusetts*, Boston, Mass., for Paper No. 2008, "Quabbin Dike Built by Hydraulic Fill Methods."

The Arthur M. Wellington Prize to RUFUS W. PUTNAM, *M. Am. Soc. C.E., President, Maritime Engineering Corporation*, Chicago, Ill., for Paper No. 2006, "The Value of Water Transportation."

The Collingwood Prize for Juniors to BENJAMIN K. HOUGH, JR., *Assoc. M. Am. Soc. C.E., Engineer, U.S. Engineer Department, Binghamton District*, Ithaca, N.Y., for Paper No. 2008, "Stability of Embankment Foundations."

The Rudolph Hering Medal to ALBERT J. SCHAFMAYER, *M. Am. Soc. C.E., Engineer, Board of Local Improvements, City of Chicago*, Chicago, Ill., and the late B. E. GRANT, for Paper No. 1989, "Rainfall Intensities and Frequencies.

The Construction Engineering Prize to HOWARD L. KING, *M. Am. Soc. C.E., Chief Engineer, Mason and Hanger Company, Inc.*, Lackawack, N.Y., for CIVIL ENGINEERING Paper No. 983, "Subaqueous Tunnel Construction."

Business Meeting

New Business

Report of Tellers on Canvass of Ballot for Officers

Introduction of President-Elect and New Officers

Luncheon

Fifth floor, Engineering Societies Building. Tickets $1.00 each.

Assist the Committee by Registering and Obtaining Tickets Early

General Meeting and Student Conference

WEDNESDAY—January 17, 1940—Afternoon

Auditorium

2:30 The Standards of Professional Relations and Conduct

DANIEL W. MEAD, *Past-President and Hon. M. Am. Soc. C.E., Professor Emeritus, Hydraulic and Sanitary Engineering, University of Wisconsin,* Madison, Wis.

3:15 Discussion

4:00 Student Chapter Conference

Following the general meeting, the chairman of the Metropolitan Conference of Student Chapters, Frank Griffin, will take over the conduct of the meeting, which will be in the form of a Student Chapter Conference. The principal topic will be "The Social Status of the Engineer." All student representatives are expected to participate.

Sessions of Technical Divisions

WEDNESDAY—January 17, 1940—Afternoon

SOIL MECHANICS AND FOUNDATIONS DIVISION

CARLTON S. PROCTOR, *Chairman, Executive Committee, Presiding*

2:15 Foundations for the Huey P. Long Bridge at New Orleans

WILLIAM P. KIMBALL, *Assoc. M. Am. Soc. C.E., Professor, Civil Engineering, Thayer School of Civil Engineering, Dartmouth College,* Hanover, N.H.

2:45 Discussion opened by

GLENNON GILBOY, *Assoc. M. Am. Soc. C.E., Associate Professor, Soil Mechanics, Massachusetts Institute of Technology,* Cambridge, Mass.

W. S. HOUSEL, *Assoc. M. Am. Soc. C.E., Research Consultant, State Highway Department; Associate Professor, Civil Engineering, University of Michigan,* Ann Arbor, Mich.

3:15 The Application of Soil Mechanics in Building the New York World's Fair

GEORGE L. FREEMAN, *M. Am. Soc. C.E., Consulting Engineer,* GEORGE W. GLICK, *Associate Engineer, and* HAMILTON GRAY, *Jun. Am. Soc. C.E., Engineer, Moran, Proctor, Freeman and Mueser,* New York, N.Y.

3:45 Soil Mechanics Laboratory Work for the New York World's Fair

DONALD M. BURMISTER, *Assoc. M. Am Soc. C.E., Assistant Professor of Civil Engineering, Engineering School, Columbia University,* New York, N.Y.

4:15 Discussion opened by

GREGORY P. TSCHEBOTAREFF, *M. Am. Soc. C.E., Assistant Professor, Civil Engineering, School of Engineering, Princeton University,* Princeton, N.J.

M. J. HVORSLEV, *Assoc. M. Am. Soc. C.E., Research Engineer,* Cambridge, Mass.

SANITARY ENGINEERING DIVISION

H. W. STREETER, *Chairman, Executive Committee, Presiding*

2:30 Presentation of Reports of Division Committees

(1) Committee on Advancement of Sanitary Engineering

CHARLES GILMAN HYDE, *M. Am. Soc. C.E., Professor of Sanitary Engineering, University of California,* Berkeley, Calif., *Chairman.*

(2) Committee on Sewage Treatment Costs (Progress Report)

WILLIAM E. STANLEY, *M. Am. Soc. C.E., Professor, Sanitary Engineering, School of Civil Engineering, Cornell University,* Ithaca, N.Y., *Chairman.*

(3) Committee on Water Supply Engineering (Progress Review, 1930–1940)

THOMAS H. WIGGIN, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y., *Chairman.*

(4) Committee on Rudolph Hering Medal Award

LEON B. REYNOLDS, *M. Am. Soc. C.E., Professor, Hydraulic and Sanitary Engineering, Stanford University,* Stanford University, Calif., *Chairman.*

(5) Progress Reports of Other Standing Committees

General Discussion

Dinner, Reception, and Dance

WEDNESDAY—January 17, 1940—Evening

Hotel Waldorf-Astoria

Committee: E. WARREN BOWDEN, *Chairman,* JOSEPH W. BARKER, EDWARD P. PALMER, SHERMAN GLASS, ANTHONY V. RIZZI, *and* FRANKLYN C. ROGERS

7:00 Assembly

7:45 Dinner

9:30 Reception to the President and Honorary Members

10:00 Dancing

This function will be held in the Grand Ballroom of the Hotel Waldorf-Astoria, Park Avenue and 50th Street.

Dinner will be served promptly at 7:45 p.m.

Arrangements have been made for tables seating ten persons, and members may underwrite complete tables. Orders to underwrite a table must be accompanied by check in full and a list of guests.

Tickets will be $6.00 each. Tickets for Juniors, for the dance only, will be $2.00 per couple.

The seating list for the dinner dance will close at 5:00 p.m., Tuesday, January 16, 1940. Those who purchase tickets after that hour will be assigned to tables in the order of purchase. Tickets will be on sale at Society Headquarters until 5:00 p.m., Wednesday, January 17, 1940.

Sessions of Technical Divisions Occupy Entire Day

THURSDAY—January 18, 1940—Morning

SANITARY ENGINEERING DIVISION

H. W. STREETER, *Chairman, Executive Committee, Presiding*

10:00 **Sewage Disposal Program for the New York Interstate Sanitation Area**

SETH G. HESS, *M. Am. Soc. C.E., Chief Engineer, Interstate Sanitation Commission*, New York, N.Y.

10:45 **Sewage Disposal Problems of the Main Subdivisions of the New York Area**

(1) **Areas West of the Hudson River**

CLARENCE J. VELZ, *Assoc. M. Am. Soc. C.E., Professor of Sanitary Engineering, and Head, Civil Engineering Department, Manhattan College*, New York, N.Y.

(2) **New York City Area**

RICHARD H. GOULD, *M. Am. Soc. C.E., Deputy Commissioner, Department of Public Works*, New York, N.Y.

(3) **Westchester and Long Island Areas**

JAMES L. BARRON, *Assoc. M. Am. Soc. C.E., Director, Division of Sanitation, Nassau County Department of Health*, Mineola, N.Y.

General Discussion

WATERWAYS DIVISION

RALPH H. MANN, *Member, Executive Committee, Presiding*

10:00 **Symposium on Organization and Operation of the Port of New York**

(1) **Duties and Relationships of the Federal, State, and Municipal Agencies; Freight Handling Methods, Rail Freight Transfers, Ship Services, Ship Repair, etc.**

CHARLES L. HALL, *M. Am. Soc. C.E., Colonel, Corps of Engineers, U.S.A., U.S. District Engineer*, New York, N.Y.

(2) **Port Properties and Developments of the Municipalities**

J. A. MEEHAN, *M. Am. Soc. C.E., Acting Chief Engineer, Department of Docks*, New York, N.Y.

(3) **Operations and Plans of the Port Authority of New York**

GLENN S. REEVES, *M. Am. Soc. C.E., Engineer, Port Development, The Port of New York Authority*, New York, N.Y.

(4) **Interests and Operations of the Navy**

RALPH WHITMAN, *M. Am. Soc. C.E., Rear-Admiral, C.E.C., U.S.N., Public Works Officer, 3d Naval District, New York, N.Y.*

General Discussion

SOIL MECHANICS AND FOUNDATIONS DIVISION

CARLTON S. PROCTOR, *Chairman, Executive Committee, Presiding*

10:00 **The Design of Building Foundations as Influenced by Developments in Soil Mechanics**

ARTHUR CASAGRANDE, *Assoc. M. Am. Soc. C.E., Assistant Professor of Civil Engineering*, and E. R. FADUM, *Jun. Am. Soc. C.E., Instructor in Civil Engineering, Harvard University*, Cambridge, Mass.

10:30 **Discussion opened by**

KARL VON TERZAGHI, *M. Am. Soc. C.E., Visiting Lecturer, Harvard University*, Cambridge, Mass.

D. W. TAYLOR, *Assoc. M. Am. Soc. C.E., Assistant Professor, Soil Mechanics, Massachusetts Institute of Technology*, Cambridge, Mass.

10:55 **Presentation of Report on "Selected Bibliography on Soil Mechanics"**

WILLIAM P. CREAGER, *M. Am. Soc. C.E., Consulting Engineer*, Buffalo, N.Y., *Chairman.*

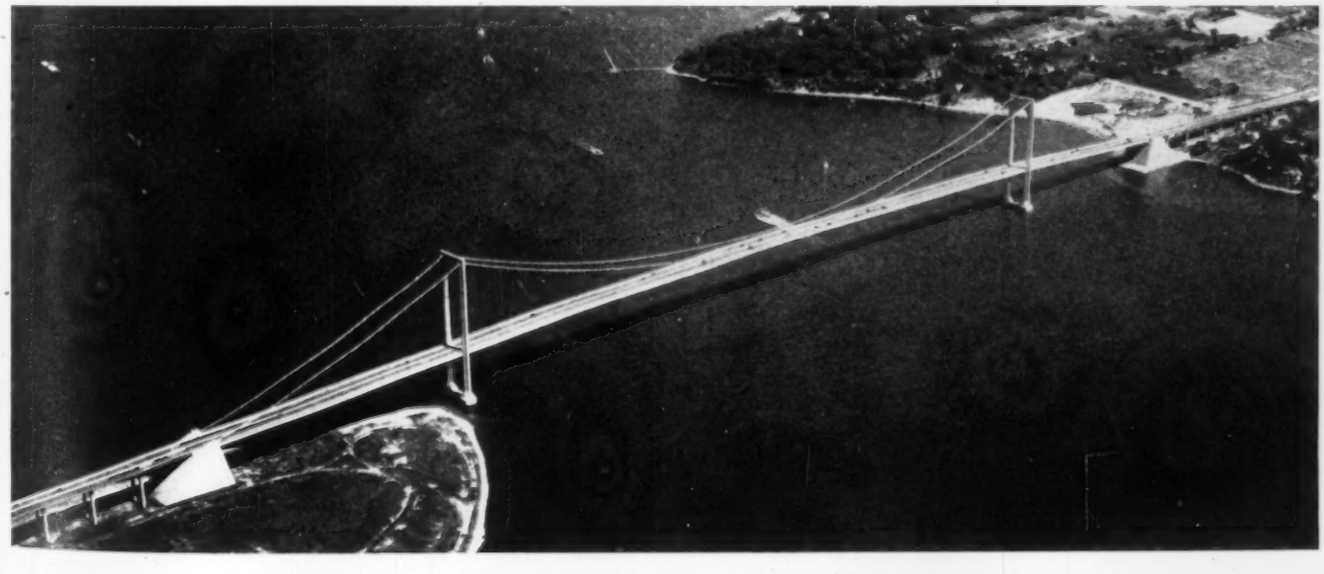
11:00 **Settlement Due to Excavation**

KARL VON TERZAGHI, *M. Am. Soc. C.E., Visiting Lecturer, Harvard University*, Cambridge, Mass.

11:30 **Discussion opened by**

CARLTON S. PROCTOR, *M. Am. Soc. C.E., Consulting Engineer*, New York, N.Y.

H. A. MOHR, *M. Am. Soc. C.E., Assistant Manager, Raymond Concrete Pile Company*, Boston, Mass.



BRONX-WHITESTONE BRIDGE TO BE SEEN ON SATURDAY INSPECTION TRIP

Sessions of Technical Divisions (*Continued*)

THURSDAY—January 18, 1940—Afternoon

WATERWAYS DIVISION

RALPH H. MANN, *Member, Executive Committee, Presiding*

2:30 Continuation of Symposium on Organization and Operation of the Port of New York

(5) The Bayonne Terminal

MARCEL GARSAUD, *M. Am. Soc. C.E., Consulting Engineer*, Jersey City, N.J.

Discussion opened by

E. E. HALMOS, *M. Am. Soc. C.E., Associate, Parsons, Klapp, Brinckerhoff and Douglas*, New York, N.Y.

(6) The Function, Design, and Construction of the North Beach Airport

BREHON B. SOMERVELL, *M. Am. Soc. C.E., Lieutenant-Colonel, Corps of Engineers, U.S.A., Administrator WPA*, New York, N.Y.

Discussion opened by

E. P. GOODRICH, *M. Am. Soc. C.E., Consulting Engineer*, New York, N.Y.

HIGHWAY DIVISION

L. G. HOLLERAN, *Chairman, Executive Committee, Presiding*

2:30 Channelization of Motor Traffic

GUY KELCEY, *M. Am. Soc. C.E., Sales Manager, Signal Service Corporation*, Elizabeth, N.J.

STRUCTURAL DIVISION

R. S. JOHNSTON, *M. Am. Soc. C.E., Director of Research, John A. Roebling's Sons Company*, Trenton, N.J., *Presiding*

2:30 Fatigue Failures in Service

B. R. LEFFLER, *M. Am. Soc. C.E., Engineer of Bridges, New York Central Railroad*, Cleveland, Ohio.

3:15 Review of European Data on Fatigue and Impact in Structures

F. H. FRANKLAND, *M. Am. Soc. C.E., Chief Engineer, American Institute of Steel Construction, Inc.*, New York, N.Y.

3:45 Critical Review of Static and Fatigue Tests of Riveted Joints

JONATHAN JONES, *M. Am. Soc. C.E., Chief Engineer, Fabricated Steel Construction, Bethlehem Steel Company*, Bethlehem, Pa.

4:30 General Discussion

3:00 Investigation of the Expansion of Concrete as Influenced by a Chemical Reaction Between the Type of Cement and Type of Aggregate

THOMAS E. STANTON, JR., *M. Am. Soc. C.E., Materials and Research Engineer, State Division of Highways*, Sacramento, Calif.

3:30 General Discussion

Entertainment for the Ladies—Beefsteak Supper and Smoker for the Men

THURSDAY—January 18, 1940

Afternoon

BEHIND-THE-SCENES TOUR OF MACY'S FOLLOWED BY TEA—THEATER PARTY IN THE EVENING—FOR THE LADIES

Committee: E. L. MACDONALD, *Chairman*, F. R. W. CLEVERDON, ALAN L. SLATON, ARTHUR DALPHOND, WOODMAN F. SCANTLEBURY, and EUGENE QUIRICONI

2:30. The executives of the big R. H. Macy Store at Herald Square have undertaken to entertain the ladies on the afternoon of January 18. They count on doing this by a display and explanation of many of the "behind the scenes" operations that are necessary to land the merchandise on the counters in the store in attractive shape to be sold.

The tour will take in such departments as the training school for employees, their hospital and their cafeteria; it will also include the stock rooms where the huge reserves of merchandise are piled up and priced, and a rather thorough exposition of the Bureau of Standards and its methods of testing the endurance and value of a variety of articles ranging from roller skates to silk stockings. The operation of the vital functions of receiving goods into the store and of discharging them by means of the delivery system will be disclosed by visits to these departments.

Ladies going on this tour will enter the store at 151 West 34th Street, near Seventh Avenue, where they will go by elevator to the Sixth Floor. Parties of 20 to 25 ladies each will then be made up and conducted on the tour, which will occupy about an hour.

3:30 Tea and Refreshments

Following the tour, the ladies will be served tea and light refreshments in Macy's Restaurant.

Tickets for the afternoon's entertainment are 50 cents each.

Evening

7:30 Performance at Radio City Music Hall

A block of seats has been reserved for the performance at the Radio City Music Hall, Rockefeller Center, 1260 Sixth Avenue, New York, N.Y.

Tickets for the performance are $1.65 each.

BEEFSTEAK SUPPER AND ENTERTAINMENT INCLUDING SMOKES AND REFRESHMENTS

THURSDAY—January 18, 1940—Evening

Committee: GLENN S. REEVES, *Chairman*, R. R. GRAHAM, VINCENT R. CARTELLI, CHESTER L. DALZELL, VALENTINE E. DYER, and FRANCIS S. HARVEY

Place—Mecca Temple Casino

Time—Doors open 6:15 p.m. Supper served, 7:00 p.m.

Members this year will be treated to an innovation in the form of a Beefsteak Supper and Entertainment.

Following the supper, there will be a period of entertainment, the plans for which the committee refuses to divulge.

Of course there will be the customary smokes and refreshments, with plenty of time for meeting friends and good fellowship.

As it may be necessary to limit the number of tickets, members are urged to make reservations early.

Members' Tickets—$2.00 each.

Guest Tickets—$3.00 each.

Sessions of Technical Divisions

FRIDAY—January 19, 1940—Morning

STRUCTURAL DIVISION

HALE SUTHERLAND, *M. Am. Soc. C.E., Head, Department of Civil Engineering, and Director of Fritz Engineering Laboratory, Lehigh University,* Bethlehem, Pa., *Presiding*

9:30 **Some Problems of Concrete Design**

HARDY CROSS, *M. Am. Soc. C.E., Professor, Civil Engineering, Yale University,* New Haven, Conn.

9:45 **The Practice of State Highway Departments in the Design of Abutments**

E. A. MACLEAN, *M. Am. Soc. C.E., Professor, Civil Engineering, and Head of Department, Rose Polytechnic Institute,* Terre Haute, Ind.

10:15 **What Do We Know About Concrete Slabs?**

N. M. NEWMARK, *Assoc. M. Am. Soc. C.E., Research Assistant Professor, Civil Engineering, University of Illinois,* Urbana, Ill.

Discussion

11:30 **Progress Report of Committee on Fundamentals Controlling Structural Design**

A. V. KARPOV, *M. Am. Soc. C.E., Consulting Engineer,* Pittsburgh, Pa., *Chairman.*

Final Report of Committee on Wind Bracing in Steel Buildings

C. R. YOUNG, *M. Am. Soc. C.E., Professor, Civil Engineering, University of Toronto,* Toronto, Ont., Canada, *Chairman.*

Final Report of Committee on Flame Cutting of Structural Steel

MILTON MALE, *Assoc. M. Am. Soc. C.E., Research Engineer, U.S. Steel Corporation of Delaware,* Pittsburgh, Pa.

Discussion

POWER DIVISION

WILLIAM P. CREAGER, *Chairman, Executive Committee, Presiding*

10:00 **Round-Table Discussion of Power Division Policy and Program for Future Work**

Members of the Division are requested to attend and give the Executive Committee the benefit of their opinions.

CITY PLANNING DIVISION

HARLAND BARTHOLOMEW, *Chairman, Executive Committee, Presiding*

10:00 **Community Planning Measures to be Undertaken During Neutrality as Part of a Preparedness Program**

10:00 **Responsibility of the City Planner**

JUSTIN R. HARTZOG, *M. Am. Soc. C.E., City Planning Consultant,* Cambridge, Mass.

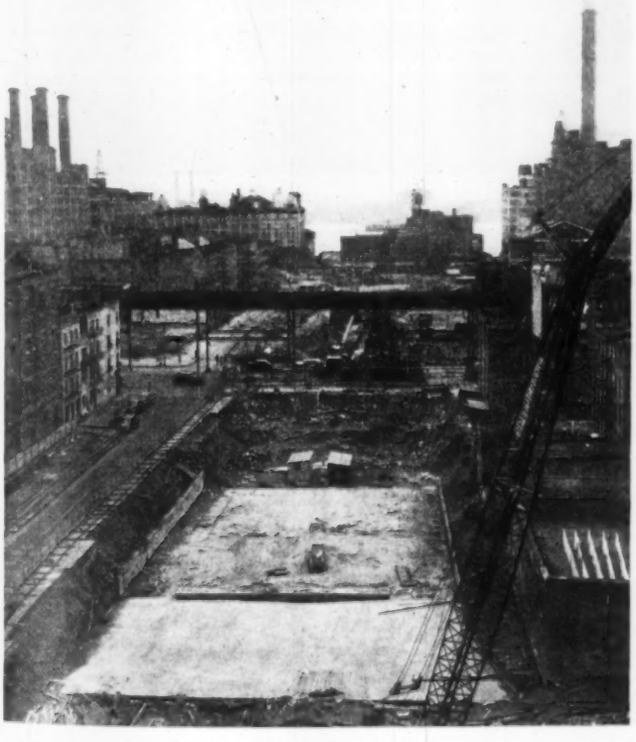
10:30 **Public Housing and City Rebuilding**

JACOB L. CRANE, JR., *M. Am. Soc. C.E., Consulting Engineer,* Chicago, Ill., and *Assistant Administrator, U.S. Housing Authority,* Washington, D.C.

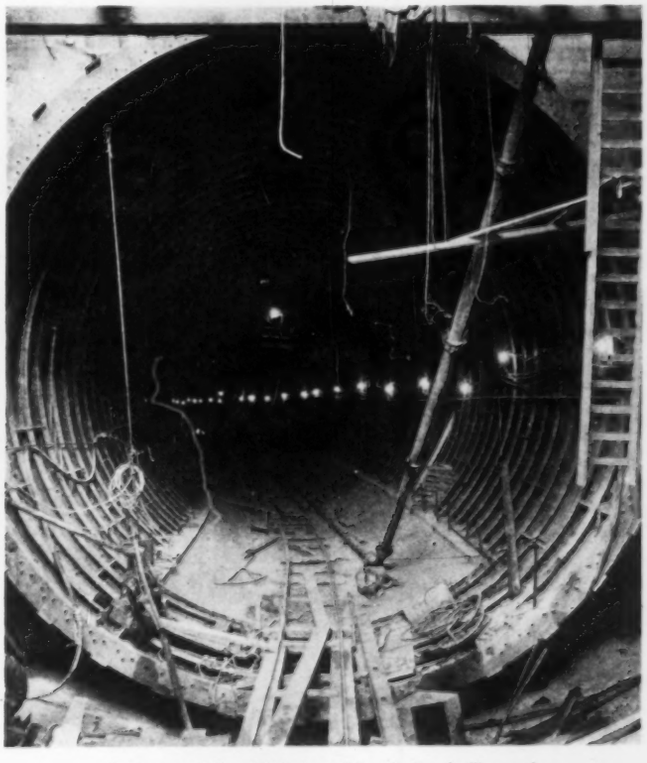
11:00 **Transport and Traffic Problems in Metropolitan Areas**

E. P. GOODRICH, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y.

11:30 **General Discussion**



General View of Manhattan Exit Plaza



Structural Steel Lining, North Rock Tunnel

QUEENS MIDTOWN TUNNEL CONSTRUCTION

Inspection and Sightseeing Trips Occupy Friday Afternoon

FRIDAY—January 19, 1940—Afternoon

COMMITTEE: R. R. NACE, *Chairman*, HOWARD L. KING, and E. A. PRENTIS

2:30 INSPECTION AND SIGHTSEEING TRIPS

Arrangements have been made for visits to the following points of interest:

LADIES' TRIP TO AMERICAN MUSEUM OF NATURAL HISTORY

QUEENS MIDTOWN TUNNEL UNDER EAST RIVER

SANITARY ENGINEERING RESEARCH LABORATORY, NEW YORK UNIVERSITY

SOIL MECHANICS LABORATORY, COLUMBIA UNIVERSITY

As all the above trips start at the same hour, it will not be possible to participate in more than one. Members will proceed individually to the rendezvous point named for the trip that is selected, so as to arrive at the time given.

TRIP FOR LADIES TO THE AMERICAN MUSEUM OF NATURAL HISTORY

Arrangements have been made for a guided tour of the museum designed to be of special interest to ladies. Of particular appeal to ladies will be the original paintings that are made "on location" or in the field that are later incorporated in the small miniature models of the groups along with models of the animal and plant life to be depicted. Another fascinating activity to be seen is the work of the artists who reproduce artificially the plant life and ground work of the habitat groups. Through the use of wax, plaster, crepe paper, wire, and other materials, realistic flowers, trees, and rock masses are produced. Other high spots are many new exhibits such as the new Dinosaur Hall, the Whitney Bird Hall, new groups in the Akeley African Hall, and in the Hall of Ocean Life.

The tour of the museum will begin at 2:30 p.m. and is expected to occupy about an hour and a half.

For those who may desire, it will be possible to attend a performance at the Hayden Planetarium, which starts at 3:30 p.m. The admission charge for the Planetarium performance is 25 cents.

The museum may be conveniently reached by Broadway bus (No. 7) or by Eighth Avenue bus (No. 10) to 79th Street, or by Eighth Avenue Subway to 81st Street. The ladies will assemble on the first floor, entering the museum at the Roosevelt Memorial Entrance, Central Park West.

QUEENS MIDTOWN TUNNEL UNDER EAST RIVER

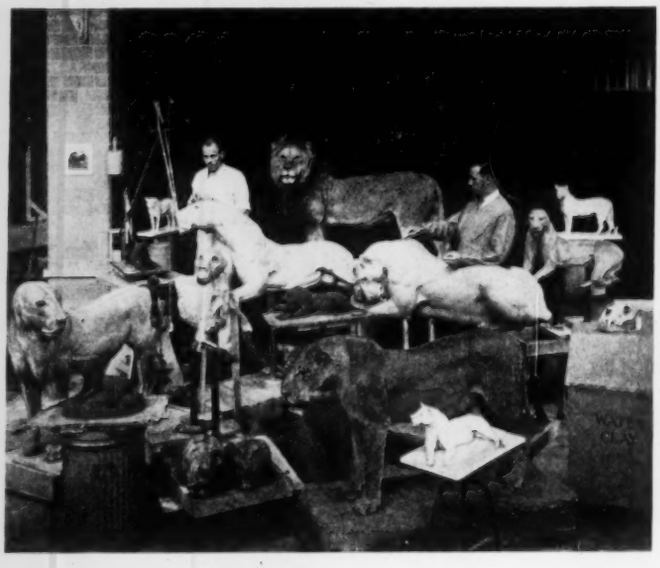
Members taking this trip will go directly to the Manhattan Plaza of the Queens Midtown Tunnel, at the northeast corner of Second Avenue and 36th Street.

Among the features of the trip will be the excavation and concrete work of the Manhattan and Queens exit and entrance plazas;

VIEW OF THE NORTH TUNNEL SHOWING THE CONCRETING OF THE FRESH-AIR DUCT AND INVERT

completion of the structural steel-lined tunnels in rock and the placing of the interior concrete work; completion of the cast-iron lining of the shield-driven twin tubes under the East River and the various stages of the concrete interior work; ventilation buildings and shafts and the installation of ventilating equipment.

Those who desire may walk through the tunnel to Queens.



"Sculptedermists" at work on Lion Group for Akeley Hall

Painted Background for Congo Forest Bird Group

AMERICAN MUSEUM OF NATURAL HISTORY

Friday Inspection Trips (*Continued*)

SANITARY ENGINEERING RESEARCH LABORATORY, NEW YORK UNIVERSITY

The Sanitary Engineering Research Laboratory at the College of Engineering of New York University, constructed jointly with the City of New York, will be of great interest to many engineers and educators. The laboratory is one of the finest of its type in the world and offers unusual facilities for the prosecution of research problems of large variety and scope, as well as providing for the training of selected City of New York employees in Sanitary Engineering.

The investigational facilities comprise not only large and completely equipped chemical and bacteriological laboratories for group use, but also include eight separate laboratory rooms for individual research projects. In addition, there is a large tank room with numerous tanks, pumps, filters, meters, etc., which provide for handling a sewage flow of 100,000 gal per day. A water flow of 25,000 gal per day may also be handled through a rapid sand filter. Experiments may not only be conducted in the test-tube stage but may also be performed upon a sufficiently large scale to reproduce actual conditions in practice.

The facilities are housed in a new three-story building, devoted solely to Sanitary Engineering. Among the outstanding research projects now in process is the sanitary land-fill investigation which is being carried on jointly by the College of Engineering and the Department of Sanitation of New York City. The scope of this comprehensive investigation which has just gotten under way embraces sampling and chemical analyses, temperature studies, loading tests, gas analyses, classification of all refuse, fly nuisance studies, and synthetic garbage land-fills which will be made at the laboratory. Other current investigations of interest are those on the model analyses of rapid sand filters, sewage sludge incineration, and bio-extraction of sewage.

Those who are planning to visit the laboratory and who intend to come by subway are advised to go to the Grand Central Station subway station, on the East Side I.R.T. line, and take an uptown Lexington-Jerome Avenue express to Burnside Avenue. A walk of four short blocks to the west along Burnside Avenue will bring one to University Avenue and the campus. From this point visitors will be directed to the Sanitary Laboratory. Those who come by car are advised to travel north on the West Side Highway along the Hudson River to Dyckman Street, which is about one mile north of the George Washington Bridge, thence east on Dyckman Street to Broadway, then north on Broadway to 207th Street, and then east on 207th Street across the Harlem River Bridge to the campus of New York University, which lies to the south and east of the bridge. Location maps may be obtained at the Registration Desk.

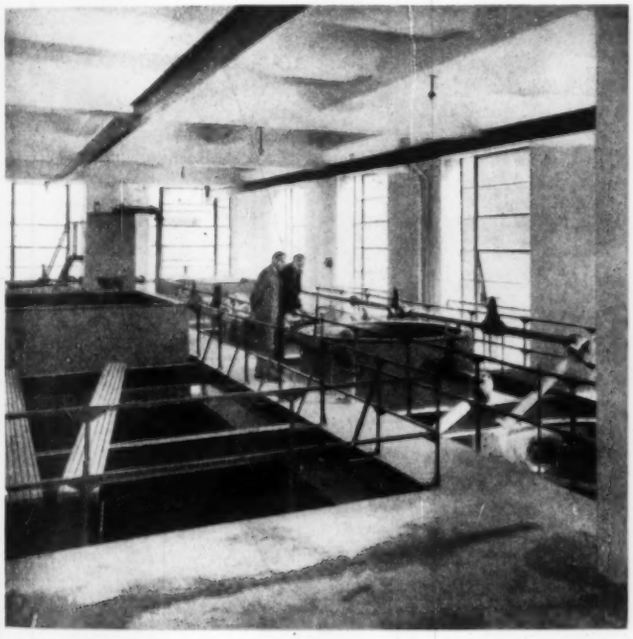
SOIL MECHANICS LABORATORY, COLUMBIA UNIVERSITY

Through the courtesy of the Department of Civil Engineering, arrangements have been made for an inspection of the Soil Mechanics and other laboratories at Columbia University.

Visitors will also have the opportunity of seeing demonstrations in the Materials, Photo-elastic, and Fluid Mechanics laboratories.

Columbia University may be conveniently reached by the I.R.T. Seventh Avenue Subway by taking uptown express trains marked either Van Cortlandt Park or 137th Street and Broadway, to the 116th Street station. Leaving the 116th Street station, visitors will walk one block north on Broadway to Earl Hall entrance, 117th Street and Broadway. The Engineering Building is directly north of this entrance.

Columbia University may also be reached by taking Fifth Avenue buses marked No. 4, 5, or 19, to 116th Street and Riverside Drive, walking thence east to Broadway and one block north to Earl Hall entrance at 117th Street and Broadway.



SANITARY ENGINEERING RESEARCH LABORATORY, NEW YORK UNIVERSITY

RANDALLS ISLAND TRAFFIC CIRCLE. TRIBOROUGH BRIDGE IN BACKGROUND. POINT OF INTEREST ON SATURDAY

2:30 P.M. MOTION PICTURE SHOWING OF CONSTRUCTION ON BOARD OF WATER SUPPLY AQUEDUCT

FRIDAY—January 19, 1940—Afternoon

Through the courtesy of the Board of Water Supply, arrangements have been made for a showing of a motion picture film illustrating tunnel and dam construction and hydraulic model tests. The film is to be shown in Room 1, Fifth Floor, Engineering Societies Building.

Inspection Trips for Saturday

SATURDAY—January 20, 1940

INSPECTION AND SIGHTSEEING TRIPS

Arrangements have been made for visits to the following points of interest:

INSPECTION OF PARKWAYS AND BRIDGES

INSPECTION OF THE METROPOLITAN LIFE INSURANCE COMPANY'S "PARKCHESTER" HOUSING PROJECT

TRIP FOR SANITARY ENGINEERS

As all the above trips start at approximately the same hour, it will not be possible to participate in more than one. Members will proceed individually to the rendezvous point named for the trip that is selected, so as to arrive at the time given.

9:30 A.M. INSPECTION OF PARKWAYS AND BRIDGES

Through the courtesy of the Department of Parks, arrangements have been made for a tour of many recent parkway and bridge projects.

The party will assemble at the Department of Parks Arsenal, 64th Street and Fifth Avenue, the trip starting at 9:30 a.m. sharp.

The trip will proceed west via the Zoo, thence northward on the Henry Hudson Parkway for a view of the West Side Improvement. The route will then follow the Cross Country Parkway eastward, thence southward on the Hutchinson River Parkway to Pelham Bay Park.

Proceeding from Pelham Bay Park, the excursion will cross the Bronx-Whitestone Bridge taking the Belt Parkway past Fort Totten to the Clearview Golf Club, where a short stop will be made. On leaving the Clearview Golf Club, the trip will follow the Cross Island Parkway, Laurelton Parkway, and Cross Bay Boulevard to the Rockaway Improvement, where a stop will be made for luncheon at Grogan's Restaurant.

Following luncheon, the trip will follow Beach Channel Drive, through Jacob Riis Park, thence over the Marine Parkway Bridge and Flatbush Avenue to the Belt Parkway, where a short stop will be made. The excursion will then traverse Kings Highway, Eastern Parkway, Interboro Parkway, Grand Central Parkway, returning to Manhattan via the Triborough Bridge.

It is expected that the trip will end about 4:30 p.m.

There will be no charge for tickets, but members will pay individually for their luncheon at Grogan's Restaurant.

10:00 A.M. INSPECTION OF THE METROPOLITAN LIFE INSURANCE COMPANY'S "PARKCHESTER" HOUSING PROJECT

Through the courtesy of the Metropolitan Life Insurance Company, an inspection of the Company's Housing Project "Parkchester" has been arranged.

The Company is now engaged in building on 129 acres in the Bronx, New York City, a park-apartment community for 42,000 persons. There will be 42,000 rooms separated into 12,269 apartments of from two to five rooms. Never before has a housing plan of such scope been carried into effect in this country.

Parkchester will be virtually a new "town" in one of the boroughs of the greater city. It will have five parks and other recreational areas, groups of "neighborhood" stores conveniently located for daily needs, a major shopping center, two large theaters, and five garages with a combined capacity of from 2,500 to 3,000 cars. The master plan provides to a most unusual extent for the leisure time needs of both adults and children. In addition to parks, there will be shaded walks and malls, playgrounds, wading pools, roller skating paths, softball diamonds, and possibly handball courts.

There are to be 51 groups of buildings comprising 171 units with automatic elevators. The buildings are fireproof and will range in height from 6 to 12 stories. They will occupy 27.4% of the land, or 35.5 acres. The landscaped and recreational areas will cover 51.4% of the land, or 66.6 acres. Streets will cover the remaining 21.2%, or 27.4 acres.

The conventional street plan was completely abandoned in the conception of Parkchester. Two broad, tree-lined parkways, each over 100 feet wide, will extend in curving fashion diagonally across the community. At the center where they meet is a large oval park.

Parkchester is designed for families of moderate income and the first buildings will be rented for March 1940.

The "Parkchester" project may be most conveniently reached by the I.R.T. subway. Members taking this trip should take any I.R.T. Lexington Avenue express train to the 125th Street station. At the 125th Street station change to a Pelham Bay local getting off at the 177th Street station, going thence to the Renting Office at 2021 Westchester Avenue, where the group will assemble for the inspection.

HENRY HUDSON BRIDGE AND PARKWAY LOOKING SOUTH

RECENT AIR VIEW OF "PARKCHESTER"

TRIP FOR SANITARY ENGINEERS

A trip of interest to sanitary engineers has been arranged by the New York State Sewage Works Association. Members of the Sanitary Engineering Division are invited to join this excursion. See under "General Announcements" for details of the New York State Sewage Works Association program and excursion. Members of the New York State Sewage Works Association are cordially invited to attend the sessions of the Sanitary Engineering Division on Wednesday and Thursday, January 17 and 18.

College Reunions Throughout the Week

THURSDAY—January 18, 1940

Luncheon of Brown Engineering Association

The Brown Engineering Association will hold an informal luncheon meeting at the Hotel Bristol, 129 West 48th Street, New York, N.Y., on Thursday, January 18, 1940, at 12:30 p.m. All Brown alumni are invited. Please notify Sydney Wilmot, 33 West 39th Street, New York, N.Y. (Pennsylvania 6–9220).

Luncheon of Chi Epsilon Honorary Civil Engineering Fraternity

Members of Chi Epsilon, their families and their friends, are again extended a cordial invitation to attend a very informal luncheon at the Midston House, 22 East 38th Street, New York, N.Y., on Thursday, January 18, 1940, at 1:15 p.m. Notify R. I. Land, 100 East 42nd Street (Ashland 4–3300, Ext. 194), or H. T. Larsen, Room 1610, 33 West 39th Street (Pennsylvania 6–9220, Ext. 87). The charge will be $1.00 per person.

Lehigh Engineers

No special gathering of the Lehigh Engineering Alumni will be held. Lehigh engineers will see each other at the beefsteak supper and smoker on Thursday evening, January 18, 1940.

University of Illinois Engineers' Dinner

The twelfth annual informal dinner this year will be held, perforce, in connection with, and at the time and place of, the Society's beefsteak supper. The full notice of the beefsteak supper is given elsewhere in this issue. In the spirit of the occasion there will be no organized segregation of college groups, but there will be a wider-than-ever opportunity to meet your friends and acquaintances from Illinois and other schools. At the same time we hope to commandeer one or two tables by ourselves, unofficially. If you are interested in joining us please leave your name with Harold T. Larsen, Room 1610, Engineering Societies Building (Pennsylvania 6–9220).

University of Pennsylvania Civil Engineers' Dinner

The twenty-first annual informal dinner of the University of Pennsylvania Civil Engineers will be held at the Phi Gamma Delta Fraternity House, 106 West 56th Street, New York, N.Y., on Thursday, January 18, 1940, from 6:00 to 7:30 p.m. Dinner will be served at 6:00 p.m. sharp. The charge per cover will be $1.25. Any further information can be obtained from Albert B. Hager, care, Atlantic, Gulf and Pacific Company, 15 Park Row, New York, N.Y.

Luncheon of M.I.T. Engineers

All M.I.T. alumni are invited to a luncheon at the Technology Club of New York, 24 East 39th Street, New York, N.Y., on Thursday, January 18, 1940, at 12:30 p.m. Please notify the Technology Club (Caledonia 5–7424) as to attendance.

FRIDAY—January 19, 1940

Dinner of Columbia Engineers

The graduates of Columbia University who are members of the Society will meet for their nineteenth informal dinner on Friday, January 19, 1940, at 6:30 p.m., at the Columbia University Club, 4 West 43rd Street, New York, N.Y. Prof. J. M. Garrelts will outline recent developments in structural research at Columbia. The guest of honor will be F. H. Frankland, M. Am. Soc. C.E., chief engineer, American Institute of Steel Construction, who will speak on "Modern Ideas of Factors of Safety." The charge will be $1.75 per cover. Address communications to J. K. Finch, Columbia University, New York, N.Y.

Dinner of Cornell Society of Engineers

A dinner of the Cornell Society of Engineers will be held on Friday, January 19, 1940, at 6:30 p.m., at the Cornell Club, 107 East 48th Street, New York, N.Y.

Harvard-Yale-Princeton Annual Huddle

The Harvard-Yale-Princeton Annual Huddle will be held at the Yale Club on Friday evening, January 19, 1940. A buffet supper will be served at 7:00 p.m., followed by a smoker, refreshments, and talks on current events. The charge will be $1.25 per cover.

Thayer Society of Engineers of Darmouth College

The annual meeting and dinner of the Thayer Society of Engineers of Dartmouth College will be held at the Dartmouth Club, 30 East 37th Street, New York, N.Y., on Friday, January 19, 1940, at 6:30 p.m.

SATURDAY—January 20, 1940

Clarkson College Alumni Dinner

The annual dinner of the Clarkson College Alumni Association will be held at the Building Trades Employers' Association Club, 26th Floor, 2 Park Avenue, New York, N.Y., on Saturday, January 20, 1940, at 6:30 p.m. There will also be an informal lunch and an afternoon meeting on the same day in the same place. Notify Frank C. Boes, 38 Cypress Street, Floral Park, N.Y., as to attendance.

COLLEGE DINNERS SUBSEQUENT TO THE ANNUAL MEETING

New York University Civil Engineering Alumni Dinner

The annual reunion dinner has been deferred to Tuesday, February 6, 1940, at 7:00 p.m., at the Roger Smith Restaurant, 40 East 41st Street, New York, N.Y. The charge will be $1.50 per plate. Send reservations to Karmy Murdichian, 458—77th Street, Brooklyn, N.Y.

Syracuse University Alumni Dinner

Graduates and former students of the College of Applied Science of Syracuse University will hold a dinner at Rutley's Restaurant, 1440 Broadway, New York, N.Y., at 6:30 p.m., on Thursday, January 25, 1940. Reservations at $1.40 per plate may be secured by writing S. F. Yasines, New York University, University Heights, New York, N.Y.

Brown University Engineering Alumni

The twenty-eighth annual dinner and the regular annual meeting of the Brown Engineering Association will be held on Wednesday January 24, at the Midston House, 38th St. and Madison Avenue at 6:30 p.m. Assembly will be at 6 p.m. to greet representatives from the university and other guests. Reservations at $1.40 per plate, may be placed with L. K. Murphy, Consolidated Edison Company, 4 Irving Place, New York, N.Y. (Stuyvesant 9–5600, Ext. 761.)

Hotel Accommodations and General Announcements

SANITARY ENGINEERS' MEETINGS, DINNER, AND INSPECTION TRIP

Following is the program of the Twelfth Annual Meeting of the New York State Sewage Works Association for Friday and Saturday, January 19 and 20, 1940, at the Hotel McAlpin, to which all members of the Sanitary Engineering Division are invited.

FRIDAY—January 19, 1940—Morning and Afternoon

8:30 **Registration—Ballroom, Hotel McAlpin**

10:00 **Annual Business Meeting—Ballroom, Hotel McAlpin**

11:30 **The Regulation of Stream Pollution in the Raritan River Basin by the New Jersey State Department of Health**

L. FORMAN, and R. P. JOHNS, *State Department of Health*, Trenton, N.J.

12:15 **Luncheon—The Winter Garden, Hotel McAlpin—Presentation of Kenneth Allen Memorial Award**

2:15 **Improved Sewage Clarification by Pre-Flocculation Without Chemicals**

A. J. FISCHER and A. HILLMAN, *The Dorr Company, Inc.*

3:15 **Studies in Corrosion Resistance of Metals in Sewage Treatment Plants**

G. L. COX, *Development and Research Division, International Nickel Company, Inc.*, New York, N.Y.

4:00 **Problems and Progress in the Chlorination of Sewage**

F. C. SCHMELKES, *Wallace and Tiernan Company, Inc.*

FRIDAY—January 19, 1940—Evening

6:30 **Joint Dinner of Sanitary Engineering Division and New York State Sewage Works Association—Hotel McAlpin**

Price of tickets $2.50 each.

Speakers—COL. JOHN P. HOGAN, *incoming President, Am. Soc. C.E.*, and ALAN JOHNSTON, *Engineer, Wallace and Tiernan*. Entertainment during and following dinner.

SATURDAY—January 20, 1940—All Day

9:00 **Excursion to Sewage Treatment Plants in New Jersey**

Leave Hotel McAlpin at 9:00 a.m. sharp. Buffet luncheon en route. Return to New York about 3:00 p.m.

Members of Sanitary Engineering Division are invited to join this excursion.

Post-Meeting Cruise

On Saturday, January 20, the party will sail from New York at noon on the American S.S. "Robert E. Lee," reaching Norfolk in the early morning of January 21. The party will debark at Norfolk and take an all-day motor coach tour into historic Virginia, the tour ending at Virginia Beach, where the night will be spent at the Hotel Cavalier. On January 22, the day will be free at Virginia Beach for swimming, riding, golf, etc. In the late afternoon transfer by motor coach will be made to the "Robert E. Lee" which will sail from Norfolk at 7:30 in the evening, arriving in New York at 3:00 p.m. on January 23.

Make your deposit and hold your cabin if there is a chance that you will go. Reservations may be canceled later and deposit returned if plans must be changed. The rates apply to all members, their families, and friends who may wish to accompany them.

Write to the Secretary, 33 West 39th Street, New York, N.Y., or Leon V. Arnold, 36 Washington Square West, New York, N.Y., for full information.

Facilities of Engineers' Club

Members may use the dining facilities of the Engineers' Club on a cash basis. Guest cards for this purpose may be obtained at the Registration Desk. The club will also be able to accommodate a limited number of members, the price of rooms ranging from $2.50 upward. Requests for reservations should be made in advance and addressed to Society Headquarters.

Hotel Accommodations

In order to be certain of accommodations, members are urged to make definite arrangements for rooms at least a week in advance of the Annual Meeting.

Hotel Rates

HOTELS	WITHOUT PRIVATE BATH		WITH PRIVATE BATH	
	Single Room	Double Room	Single Room	Double Room
Waldorf-Astoria	.....	.....	$7.00 up	$10.00 up
Astor	.....	.....	3.50 up	6.00 up
Barclay	.....	.....	5.00 up	8.00 up
Biltmore	.....	.....	6.00 up	8.00 up
Chatham	.....	.....	5.00 up	7.00 up
Claridge	.....	.....	2.00 up	3.00 up
Commodore	.....	.....	3.50 up	5.00 up
Edison	.....	.....	3.00 up	4.00 up
Governor Clinton	.....	.....	3.00 up	4.00 up
Lexington	.....	.....	3.50 up	5.00 up
McAlpin	2.50 up	4.00 up	3.50 up	5.00 up
Murray Hill	2.00 up	3.00 up	2.50 up	4.00 up
New Yorker	.....	.....	3.50 up	5.00 up
Pennsylvania	.....	.....	3.50 up	5.00 up
Plaza	.....	.....	6.00 up	8.00 up
Roosevelt	.....	.....	4.50 up	7.00 up
Savoy-Plaza	.....	.....	6.00 up	8.00 up
Taft	.....	3.00 up	2.50 up	3.50 up
Vanderbilt	.....	.....	3.50 up	6.00 up
Woodward	.....	.....	2.50 up	3.50 up

NOTE: The Waldorf-Astoria, at which the reception, dinner, and dance will be held, will care for reservations to the extent of its capacity.

Order Tickets in Advance

Members who order tickets in advance will assist the Committee greatly by giving advance information to guide it in concluding arrangements. Ticket order blanks have been mailed to each member with the condensed program. No cancellation of tickets can be made after noon of Wednesday, January 17, 1940.

Regional Meeting Committee

This program has been prepared under the direction of the Committee on Regional Meetings, MALCOLM PIRNIE, *Vice-President, Am. Soc. C.E., Chairman;* and H. M. LEWIS, H. W. HUDSON, E. R. NEEDLES and WILLIAM J. SHEA, *Directors, Am. Soc. C.E.*

Committee on Local Arrangements for the Annual Meeting

ROBERT W. SAWYER, 3D, *Chairman*
GLENN S. REEVES, *Vice-Chairman*

JOSEPH W. BARKER
E. WARREN BOWDEN
F. R. W. CLEVERDON
R. R. GRAHAM
HOWARD L. KING
E. L. MACDONALD
R. R. NACE
EDWARD P. PALMER
E. A. PRENTIS
ALAN L. SLATON
E. W. STEARNS

Junior Members

VINCENT R. CARTELLI
ARTHUR DALPHOND
CHESTER L. DALZELL
VALENTINE E. DYER
SHERMAN GLASS
FRANCIS S. HARVEY
EUGENE QUIRICONI
ANTHONY V. RIZZI
FRANKLYN C. ROGERS
WOODMAN F. SCANTLEBURY

Ladies Committee

MRS. ROBERT W. SAWYER, 3D, *Chairman*

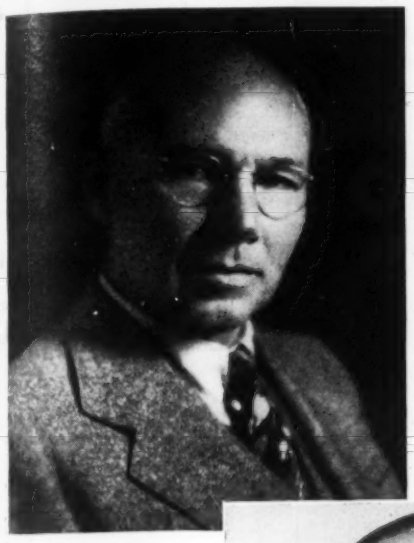
MRS. E. WARREN BOWDEN
MRS. W. G. BOWMAN
MRS. F. R. W. CLEVERDON
MRS. E. P. GOODRICH
MRS. R. R. GRAHAM
MRS. JOHN P. HOGAN
MRS. OTIS E. HOVEY
MRS. H. W. HUDSON
MRS. HOWARD L. KING
MRS. H. M. LEWIS
MRS. E. L. MACDONALD
MRS. R. R. NACE
MRS. E. R. NEEDLES
MRS. GEORGE H. PEGRAM
MRS. MALCOLM PIRNIE
MRS. E. A. PRENTIS
MRS. GLENN S. REEVES
MRS. ROBERT RIDGWAY
MRS. GEORGE T. SEABURY
MRS. WILLIAM J. SHEA
MRS. E. W. STEARNS
MRS. ARTHUR S. TUTTLE
MRS. LAZARUS WHITE

Please call on the Committee on Local Arrangements or on the Secretary's Office for any service desired.

SOCIETY AFFAIRS

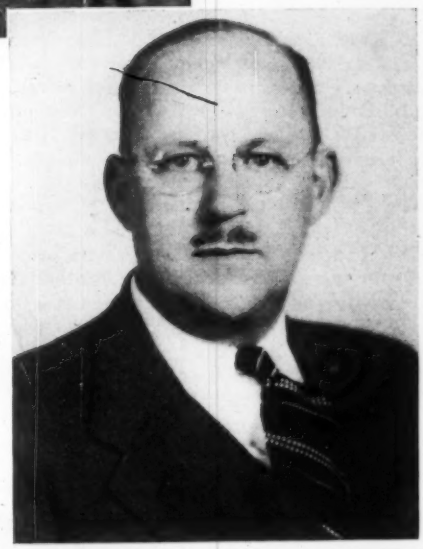
Official and Semi-Official

1939 Prize Winners and Medalists



CHARLES H. LEE
Norman Medal for Paper, "Selection of Materials for Rolled-Fill Earth Dams"

CHARLES A. MOCKMORE
J. James R. Croes Medal for Paper, "Flow Characteristics in Elbow Draft-Tubes"



STANLEY M. DORE
James Laurie Prize for Paper, "Quabbin Dike Built by Hydraulic Fill Methods"

RUFUS W. PUTNAM
Arthur M. Wellington Prize for Paper, "The Value of Water Transportation"

A. J. SCHAFMAYER
Rudolph Hering Medal for Paper, "Rainfall Intensities and Frequencies"

THE LATE BERTRAND E. GRANT

B. K. HOUGH, JR.
Collingwood Prize for Juniors for Paper, "Stability of Embankment Foundations"

Society Prizes Awarded for 1939

FOLLOWING its usual custom, the Society will present prizes and medals at its Annual Meeting to be held in New York City, January 17–20, 1940. The oldest of these Society awards is the Norman Medal, which was endowed in 1872 by the late George H. Norman, M. Am. Soc. C.E., for an original paper that is considered an especially notable contribution to the engineering profession.

Next in distinction is the J. James R. Croes Medal, established by the Society in 1912 and named for the first recipient of the Norman Medal. This award is made for the paper considered second in merit to that receiving the Norman Medal. The James Laurie Prize was also established by the Society in 1912 and named in honor of its first President.

In 1924 the Sanitary Engineering Division of the Society instituted and endowed the Rudolph Hering Medal, which goes to the author of the paper considered the most valuable contribution to the advancement of the sanitary branch of the profession.

The Arthur M. Wellington Prize for the best paper on some phase of transportation was established and endowed by the *Engineering News-Record* in 1921. Although it is not required that the recipient of this prize be a member of the Society, its award rests with the Society. In 1894 the late Francis Collingwood, M. Am. Soc. C.E., at the time of his retirement as Secretary of the Society established the Collingwood Prize for Juniors. Papers eligible for this award must describe an engineering work or record an important investigation with which the writer has been connected. Excellence of style is also a factor in the selection of the paper receiving this prize.

Biographical sketches of those receiving prizes or medals follow.

CHARLES H. LEE, M. Am. Soc. C.E., was born in Oakland, Calif., on February 1, 1883. He graduated from the University of California in 1905 with the degree of bachelor of science in civil engineering. From 1906 to 1912 he was assistant engineer for the Bureau of Los Angeles Aqueduct, City of Los Angeles, participating in surveys and design of the Owens River Aqueduct; for three years of this time he was in charge of water supply investigations. In the latter work he developed the methods for quantitative determinations of ground-water supply in closed geologic basins which are now in general use. In 1913 he entered private engineering practice in Los Angeles, Calif. During the war he served as captain, 26th Engineers, U.S. Army, with the American Expeditionary Forces in France. Upon Mr. Lee's return to the United States he was appointed president of the California State Water Commission, and later chief of the Division of Water Rights, California State Department of Public Works. Since 1921 he has been in consulting practice in San Francisco, specializing in water supply, sewage, irrigation, and drainage. In this capacity he has been connected with the Central Valley Project of the State of California, the Colorado River Project of the Metropolitan Water District of Southern California, and other engineering works. He has served as a member of the Engineering Commission on Sanitation and Drainage of the City of Oakland, and as consultant and chief of the Division of Water Supply and Sanitation, Golden Gate International Exposition. In 1936 he established the Pacific Hydrologic Laboratory for hydrologic research and engineering soil testing, and has developed new methods for selection of material for earth dams and for rendering earth construction watertight by use of bentonite or salt. Mr. Lee is the author of numerous engineering and technical articles, including two U.S. Geological Survey papers on ground-water resources. He is a member of several national engineering committees and technical organizations, and has been selected to prepare a chapter on "Transpiration and Total Evaporation" for inclusion in the volume on hydrology to be published by the National Research Council.

CHARLES A. MOCKMORE, M Am. Soc. C.E., was born in Platte Center, Nebr., on November 7, 1891. After graduating from high school in Wilton, Iowa, in 1913, he attended the State University of Iowa. During the World War he enrolled in the Engineers Enlisted Reserve Corps and, upon returning to the university, was transferred to the S.A.T.C. In the summer between his junior and senior college years he acted as foreman on the construction of the first unit of the hydraulics laboratory of the University of Iowa. He received the B.E. degree in 1920 and was awarded the "Big Ten Medal" for accomplishment in the dual field of scholarship and athletics. Following graduation, he worked as assistant to the Superintendent of Grounds and Buildings at his alma mater, and in the fall of 1921 went as instructor in civil engineering to Oregon State College, where he is now head of that department. In 1931 he took leave of Oregon State College to become research associate at Iowa where he was awarded the Ph.D. degree in 1935. During 1934 and 1935 he conducted a series of experiments for the U.S. Engineer Department on model draft tubes for the Bonneville Dam in Oregon. He is a member of Tau Beta Pi, Sigma Xi, Theta Xi, the Society for the Promotion of Engineering Education, and the Professional Engineers of Oregon, and a cooperating member of the Society's Committee on Hydraulic Research. Dr. Mockmore has taken an active part in civic affairs and at present is a member of the Common Council of the City of Corvallis, Ore. Among his technical writings are manuals on "Estimating and Cost Analysis" and "Hydraulic Machinery," and he is co-author of an Engineering Experiment Station bulletin on "A Sanitary Survey of the Willamette Valley, Oregon."

STANLEY M. DORE, M. Am. Soc. C.E., was born in Somerset, Mass., on June 19, 1898, and was graduated with the degree of bachelor of science in civil engineering from Brown University in June 1920. During the next two years he worked on drafting and design in connection with reinforced concrete building construction for the Turner Construction Company of Boston, Mass., and with reinforced concrete and steel construction for fortifications under the jurisdiction of the U.S. Engineer office in Providence, R.I. From 1922 to 1928, he was employed by the Water Supply Board of Providence, R.I., as an assistant engineer and later as assistant designing engineer on the design and construction of various hydraulic works in connection with the development of an additional water supply system consisting of an open storage reservoir, purification works, aqueduct and distribution systems, and covered distribution reservoirs. Since 1928 he has been assistant designing engineer and associate civil engineer, and is now assistant chief engineer of the Metropolitan District Water Supply Commission of Massachusetts on the design and construction of various hydraulic works for a broad extension of the water supply system of metropolitan Boston, particularly the Quabbin Reservoir and the Quabbin and the new pressure aqueducts. Mr. Dore is a member of the Alpha Tau Omega and Sigma Xi fraternities, the Boston Society of Civil Engineers, the New England Water Works Association, and the Boston City Club.

A. J. SCHAFMAYER, M. Am. Soc. C.E., was born in Council Hill Station, Ill., on April 3, 1883 He received his early education at the Scales Mound High School and the University of Illinois Academy, and later entered the University of Illinois, receiving the degree of B.S. in C.E., with honors, in 1907 and the degree of C.E. in 1914. Mr. Schafmayer was rodman for the City of Chicago in 1907 and 1908, and assistant engineer from 1908 to 1911. From the latter year until 1927 he was division engineer for the Chicago Board of Local Improvements, and from 1927 to 1929 assistant chief engineer of sewers. Since 1929 he has been engineer of the board for the Chicago Board of Local Improvements, and he occasionally serves in an advisory capacity for Mid-Western municipalities. Mr. Schafmayer served on the Chicago Subway Engineering Advisory Board in 1930; on the Engineering Committee on Chicago West Side Superhighways from 1936 to 1938; and on the Engineering Advisory Committee on the General Plan for Chicago Superhighways in 1939. He is a member of the Western Society of Engineers, the Illinois Society of Engineers (of which he was president in 1930), the National Society of Professional Engineers, and Tau Beta Pi.

BERTRAND E. GRANT was born in Troy, N.Y., on December 12, 1868. He was educated at Rensselaer Polytechnic Institute, receiving the degree of C.E. in 1890. Following his graduation, he went to Chicago, where he was employed in the division of research of the Sanitary District. He was later engaged in hydraulic power plant construction in the state of Washington and then, for several years, was in consulting engineering practice in Chicago as a member of the firm, Hill and Grant. In 1905 he became a division engineer for the Board of Local Improvements of the City of Chicago. During the World War and for two years thereafter Mr. Grant served with the U.S. Emergency Fleet Corporation, first as valuation engineer with the Division of Shipyard Plant and later as head of the Division of Shipyard Disposal. He then resumed his position as division engineer for the Chicago

Board of Local Improvements. He was the author of various technical papers and discussions. A member of the Western Society of Engineers, he served this organization as trustee, vice-president, and president. Mr. Grant died in Chicago on October 30, 1936.

RUFUS W. PUTNAM, M. Am. Soc. C.E., was born at La Crosse, Wis., on June 30, 1891. He received his early schooling in Rushford, Minn., and graduated from the U.S. Military Academy in 1913 and from the U.S. Engineer School in 1916. He was commissioned a second lieutenant in the Corps of Engineers, U.S. Army, upon graduation from the Military Academy, and served with troops in this country and in the A.E.F. in various capacities and grades, including that of lieutenant colonel. From 1922 to 1926 he was district engineer for the Chicago District of the U.S. Engineer Department, having close contact in that assignment with the problems arising from the activities of the Sanitary District of Chicago in connection with the diversion of water from Lake Michigan, and the adoption of a comprehensive program of sewage treatment for the district. In 1926 he resigned from the military service to take charge of the preparation and execution of a plan and program for harbor and waterway development in the metropolitan region of Chicago. In that work he visited many of the important harbor and river projects in this country and Europe. Since leaving the army he has been in practice as a consulting engineer, specializing in river and harbor works and inland water transportation. Mr. Putnam is a former president of the Western Society of Engineers, and of the Illinois Section of the American Society of Civil Engineers. He is a director of the Chicago Regional Planning Association and of the Chicago Regional Port Commission. He is the author of numerous articles on port and water terminal development, and water transportation, having received the Arthur M. Wellington Prize on a previous occasion (1924) for a paper on one of these subjects.

BENJAMIN K. HOUGH, JR., Jun. Am. Soc. C.E., was born in Westfield, N.J., on July 28, 1905. He received his early schooling in Brookline, Mass., and graduated from the Massachusetts Institute of Technology in 1928, receiving the degree of bachelor of science. After graduation he spent a year in Guatemala, working as surveyor for the United Fruit Company. On his return, he was employed by the Central Maine Power Company as instrumentman on construction of the Wyman Dam for the hydroelectric development at Bingham, Me. Following this he was employed in a similar capacity by the Safe Harbor Water Power Company on the development at Safe Harbor, Pa. He resigned from this position to reenter Massachusetts Institute of Technology as a graduate student in the fall of 1931 and received the degree of master of science in 1932. He subsequently became a research assistant under Dr. Glennon Gilboy in the soil laboratory there and was accepted as a candidate for the degree of doctor of science. This work was terminated by his acceptance of a position as assistant engineer in the Zanesville (Ohio) District Office of the U.S. Engineer Department in 1934. Since that time he has continued in the classified service of this department. He now has the grade of engineer and is assigned to the Binghamton (N.Y.) District Office, being stationed at Ithaca, N.Y., in charge of the district soil laboratory and foundation investigation. He has also acted in a private capacity as consultant for the New York firm of Parsons, Klapp, Brinckerhoff, and Douglas. Mr. Hough is a registered professional engineer in the state of New York, member of the Delta Tau Delta fraternity, and the author of several papers dealing with soil mechanics.

Five New Honorary Members

Biographical Notes of Eminent Engineers to Be Granted This Distinction at 1940 Annual Meeting

WILLIAM JAMES EAMES BINNIE

IN POINT of age, the Institution of Civil Engineers of London is the dean of all such engineering societies in the world. Also, in its professional ideals, in the strength of its reputation, and in its influence on technical standards and practice it is preeminent. For the office of president, it has the choice of all British civil engineers, which fact is in itself a sufficient testimony to the high reputation and ability of those chosen to fill its principal office. A man who, in addition to filling the presidency of this Institution, is also favorably known throughout the Empire and in the Western World as well, must be an outstanding figure in the world of engineering.

WILLIAM JAMES EAMES BINNIE

Such a person is W. J. E. Binnie, to whose laurels is now added the award of honorary membership in the American Society of Civil Engineers. His name is thus included in the short but select list of English engineers who have graced the rôles of the Society in this class of membership.

He comes naturally by his great engineering ability. To those that knew his father, Sir Alexander Binnie, who also had an eminent engineering practice throughout the British Empire, it is not strange that the son should have ascended to the peak of his profession. Thus, from an engineering standpoint, the circumstances of Mr. Binnie's early life were most favorable. He was born in 1867 in Londonderry, Northern Ireland. Later he had the privilege of attending Rugby and then Trinity College, Cambridge. Here he was graduated in 1888 and at the same time received honors in the "natural science tripos" by competitive examination. His degree from Cambridge was M.A.

In accordance with the best English tradition, he began his engineering training on practical work under the authority of older and established engineers. He was especially fortunate in being able to serve for three years with his father, who was at that time water works engineer of the Bradford Corporation, constructing extensive reservoirs, filters, pumping stations, and other installations. He followed up this experience by similar work for over two years on the Birmingham Water Works, under the noted engineer, James Mansergh. Beginning in 1896 and for four years, he was on the staff of Sir Benjamin Baker, being employed as resident engineer on construction work for the Central London Railway.

Both James Mansergh and Sir Benjamin Baker, as well as Sir Alexander Binnie, became presidents of the Institution of Civil Engineers. How well Mr. Binnie the younger profited by these important associations is evidenced by his later career, another example of the advantage to be obtained from the "lives of great men." His next experience was abroad. Again associated with Sir Benjamin Baker, he went, in 1900, on a two-year assignment to Egypt, where he took charge as resident engineer of the construction of the Khedival Graving Dock at Alexandria.

It was with this fine experience behind him that he returned to England in 1902, to enter upon his life work as a consulting engineer in private practice. He joined his father's firm and immediately plunged into important hydraulic and sanitary projects both at home and abroad. Soon he was called upon to take an active part in the arbitration for the purchase of the London Water Company. The firm was extended in 1909, when Martin Deacon became a partner, thus amalgamating the two practices under the firm name of Sir Alexander Binnie Son and Deacon.

After 15 years of this association, Sir Alexander Binnie died in 1917, and Mr. Binnie succeeded to the senior partnership. Among the important projects handled by the firm was the supply of

water for Birkenhead, and construction for the Taf Feachan Water Supply Board. Other important works included water supplies for Singapore, Belfast, the Durham County Water Board, Oxford, Coventry, and Kano (North Nigeria). These projects had a total value of almost $40,000,000.

In still another field Mr. Binnie has taken an active part—the development of hydroelectric power. A great deal of this work was done in connection with the Ministry of Munitions and the Water Power Resources Committee in England. But hydraulic problems outside the British Isles also engaged his study—he was adviser to the British representative on the Central Rhine Commission in 1922 in connection with the proposed French plan for the construction of a canal between Basle and Strasbourg to facilitate navigation and to develop electric energy; and later, in 1925, he was a member of the Ouse Drainage Commission. Mr. Binnie's firm has also done remarkable work on the Gorge Dam, now under construction near Hong Kong.

One of the most important of his engineering consultations was in connection with the second heightening of the Aswan Dam on the Nile River. This mammoth structure, originally built about 1900, was raised for the first time in 1912 to double the reservoir capacity. Still it proved insufficient to meet the demand and again a project was instituted to add an equal amount of storage. This was done in 1927. To make sure of the sufficiency of the proposed improvement, the Egyptian government called in a notable international technical commission, one of whose members was Mr. Binnie. It goes without saying that this major piece of work was completed to the great credit of all concerned.

Such extensive and noteworthy experience has brought wide recognition to Mr. Binnie. This has also been due partly to his writings on water supply, water power, and drainage matters.

All American engineers will regret the crisis that necessitated the canceling of the British American Engineering Congress in September 1939. If the Congress had occurred as planned, it would have enabled American engineers to become acquainted with an eminent group of British engineers, including Mr. Binnie. Not that he is unknown here, but only a few members of the Society, largely in the field of sanitation and water works, are personally acquainted with him. Those who have had the opportunity to meet him in England are unanimous in speaking of his delightful personality. He is one of the most lovable, kindly, and charming companions that a person could possibly hope to have.

Like so many other engineers who have had the opportunity for wide contacts, he is easy to meet. His hospitality in the entertainment of visiting engineers has been evidenced more than once. This was especially appreciated on the occasion of a summer meeting of the Institution of Water Engineers, at which several American engineers were present and participated in an excursion to the ruins of Fountain's Abbey. Mr. Binnie took great interest in explaining this historic ruin to his American guests, thus evidencing his knowledge in this field as well as his hospitality. His American visitors have never forgotten this occasion.

In view of his manifold gifts, it is not strange that he has been singled out for special honors among engineers and others. He has been president of the Cambridge University Engineers Association and is a fellow of the Geological Society. He is a past-president of the Institution of Water Engineers and of the Institution of Sanitary Engineers. It was for the year 1939 that he served as president of the Institution of Civil Engineers.

He has also received recognition in this country—in 1934 he was elected an honorary member of the New England Water Works Association. Thus the award to him of honorary membership in the Society makes his list of distinguished memberships in his field almost unanimous. American engineers warmly welcome Mr. Binnie into the Society, as an Honorary Member, a connection which marks the continuance of a valued association.

HERBERT SAMUEL CROCKER

SO OFTEN has H. S. Crocker been selected as a representative of engineers and of the Society that his name has become a byword, and the details of his life and engineering achievements correspondingly well known. He has filled almost every office in the Society. His professional engagements—marked by success in a wide variety of difficult work—have likewise brought him into prominence. Even at an age when many engineers are taking advantage of well-earned retirement, Colonel Crocker is still carrying on.

Perhaps he inherits this praiseworthy trait. Certainly he has a distinguished ancestry, as he comes from a family of public-spirited citizens prominent in Colonial and Revolutionary times and going back even to the Mayflower. When he was a boy, not yet in his teens, his father died, leaving his mother a widow with two young boys. Of necessity he had to work, and he has been working hard ever since. Both he and his brother went to the University of Michigan and graduated with credit. For most of his life thereafter, Herbert Samuel Crocker has been actively engaged in civil engineering work, specializing in bridges and other structures. After a few years spent designing railroad bridges, he turned his attention to the design of steel structures for the Sanitary District of Chicago. In 1897, with a total experience of about nine years, he located in Denver. Although his reputation was already established, he built upon it year by year. At various times and for relatively short periods he was employed elsewhere, but without fail he returned to his Colorado home, with a constantly enhanced record of accomplishment.

HERBERT SAMUEL CROCKER

One of his periods away from Denver was spent with the American Bridge Company in Chicago. After a few years there he returned to Denver in 1906 to work for the local tramway company designing steel structures. Shortly afterwards, in 1907, he opened his own office and has continued in practice there without interruption, except for the war period. Transportation structures—most of them in Denver but some also in Chicago and Salt Lake City—have engaged his major attention. His work in this field was crowned by the design and construction of the Colfax-Laramer Viaduct in Denver, one of the longest concrete viaducts in the world. He constructed the 14th Street viaduct in 1898 and just recently had the satisfaction of being chosen to direct the work of strengthening and widening it.

Mention must be made of one significant occurrence during this period. For two years Mr. Crocker was a member of the firm of Crocker and Ketchum, as a partner of the late Dean Milo S. Ketchum. Although the firm was in existence only a short time, it did exceptional work and enjoyed a wide reputation. The two men were entirely different in temperament, so they offset and supplemented each other. Even after their professional interests were severed, they remained fast friends and warm admirers of each other.

When the United States entered the war, Mr. Crocker was given a commission as major of engineers (later lieutenant colonel) and closed his Denver office. He gave outstanding service in the Quartermaster Department, notably as constructing quartermaster of the huge Army supply base in Brooklyn, N.Y., which cost over thirty million dollars and included the largest single concrete building built up to that time.

Before returning to Denver he contributed another important service to the profession. During part of the war period, Colonel Crocker served as a Director of the Society. At the conclusion of his military service, he again became a Society officer, this time Vice-President. When the late Charles Warren Hunt retired as Secretary of the Society in January 1920, Colonel Crocker's many friends on the Board of Direction thought he was just the person to step into the breach. This he did and served with distinction in the office of Secretary until May 1921. Colonel Crocker, with his common sense and tact, quickly won the hearts of a wide circle of members and of the Headquarters staff. Needless to say, he as well as his associates thoroughly enjoyed this period.

To pick up his engineering practice again in Denver was not easy. However, he soon obtained commissions for viaduct and bridge work in that city and in Pueblo. Later he served as a member of

the Denver Board of Water Commissioners and was appointed consulting engineer in charge of the city's ten-million-dollar trans-mountain diversion project, a complicated and extensive piece of work.

Besides his service in the various offices of the Society, he has given generously of his time to other organizations, notably as a member of the Advisory Committee on Water Resources of the National Resources Committee and on the Administrative Committee of American Engineering Council. Also, he was a member of the Mississippi Valley Commission and acted as supervising engineer for the Twin Lakes Trans-Mountain Diversion Project. He holds membership in many engineering, historical, and scientific societies, and has doctorates from the Universities of Michigan and Colorado.

Few men have a wider circle of friends than Colonel Crocker. He inspires loyalty among them and among his employees, and he returns that same loyalty with compound interest. One of his cardinal principles in his engineering practice has been to surround himself with young men and to detail responsibility to them freely. Naturally he has always been a favorite with young engineers, not only for his youthful viewpoint but for his thorough understanding of their problems.

As regards his personality, he hides a wealth of humor behind his seeming taciturnity. Among his friends he is noted for his dry wit and his ability to see the amusing side of a situation—a trait that stands him in good stead in difficult arbitration cases, for example, where it has enabled him to bring about equitable and amicable solutions with ease.

In 1932, when Colonel Crocker was in the construction business, one of his contracts covered a rather unimportant bridge over a minor stream in western Colorado. The city manager, before he would award this contract, wanted to meet the contractor so that he could ask him whether his experience and qualifications were sufficient to conduct the work according to the best engineering principles. At this question the project engineer was considerably upset, but not the Colonel, who replied gravely that he thought he could handle the construction properly. His friends enjoy this story, recalling that the Colonel was President of the Society at that very time.

He claims to know, and is perfectly willing to prove that he knows, the value of pi and of the square root of two to 29 decimal places. So that he might readily remember his automobile license number, he secured a plate for Denver County marked 1.41421 and proudly showed it to his friends, most of whom did not even recognize the remarkable sequence which so appealed to the Colonel. Later he was deeply shocked when another friend picked it out as the natural secant of 45 degrees—and would never have that number thereafter.

As might be expected, Colonel Crocker's home life is a rich one. He has reason to be proud of his family. Although the three children are now married, Colonel and Mrs. Crocker still maintain their delightful home in Denver. The Colonel is fond of all children, but naturally enough, is particularly fond of his four grandchildren.

He is a great lover of travel and invariably leaves on a trip with all the necessities of life except money. All he needs is a railroad ticket or a tank full of gasoline. He proceeds merrily on his way, and upon discovering a shortage of funds, simply stops at the first town, where he can always find an accommodating friend. His means thus replenished, he is again able to proceed with equanimity. In other respects, however, he is quite methodical. For years he has had a horror of ideas or plans arrived at on the spur of the moment. He has said on many occasions that one such "bright idea" carried out, costs more than a dozen errors made after careful thought and planning.

Asked to analyze the Colonel's character, one of his friends remarked that a vital feature of it was a certain intangible quality—an unpredictability. One feels the necessity of being prepared for almost anything, when as a matter of fact the Colonel always comes out on top and with flying colors. No wonder his friends have great confidence in him!

Like many another engineer, Colonel Crocker's favorite activity is the Society in all its phases. Few men are more cognizant of its early history and memberhip. As he has reflected great credit on the profession and on the Society through many years, so it is only right now that the Society should signalize him with the award of honorary membership.

JOHN MORRICE ROGER FAIRBAIRN

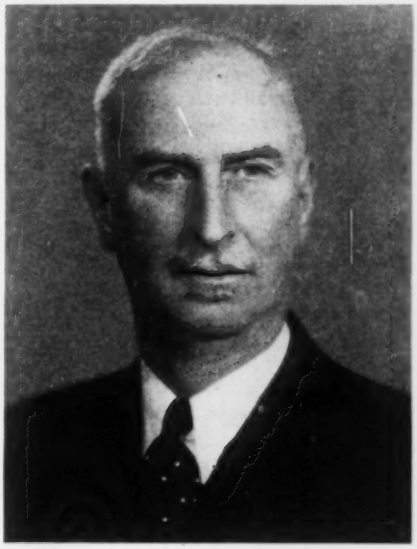
AT QUARTERLY meetings of the Society the Headquarters hotel is usually the center of informal and delightful social contact for engineer visitors from all parts of the country. On such occasions, breakfast is a particularly enjoyable time. Then minds and nerves are rested, and the somewhat rigorous duties of the day are not yet begun. The dining room is like a club, filled with members and ladies whose friendly greetings proclaim the spirit of comradeship.

On such occasions one may sometimes see an eminent member of the Society—tall and athletic looking, ruddy of countenance but bronzed by the sun, with a closely cropped mustache and goatee, and a merry twinkle in his eye. He knows everybody and is known to them. But what is most notable is his meal, which consists of one large glass of milk and one large glass of orange juice. These he sips alternately. Judging by his robustness, this diet thoroughly agrees with him.

To most of the members present he is known—John Morrice Roger Fairbairn, long-time member of the Society and one of the most distinguished engineers in the Dominion of Canada. This renown is a natural outgrowth of his life work, which has carried him all over the Dominion in the interests of the Canadian Pacific Railway.

He was born in 1873 in Peterborough, Ontario, where he received his preliminary schooling. From there he went to pursue the study of engineering at Toronto University, from which he was graduated in 1893.

Statistically, Mr. Fairbairn's engineering experience is quickly told. He entered the service of the Canadian Pacific Railway in 1892 and retired in 1939. For one year of that time, around the turn of the century, he was in private practice, but except for that the railway monopolized his energies. He started as assistant engineer, became resident engineer, assistant engineer again, then acting division engineer, and later, division engineer at various places. It was not long before he became engineer of maintenance of way, and assistant chief engineer of the Eastern Lines—eventually in charge of all engineering. For 28 years he was substantially in charge of such work, and for the latter 20 years of this period was chief engineer of the system in title as well. During his 38 years of continuous service he saw the trackage grow from 8,500 to 17,000 miles. More than that, he exercised a major influence on this development, marked by better roadbeds, heavier rails, and improved structures. His was an important function in the vast expansion of a continental rail system.



JOHN MORRICE ROGER FAIRBAIRN

It was during this period, and at the height of his activity, that the Society held it Summer Meeting in Vancouver, B.C. To the special party of members that traveled from Chicago and the East to this meeting, Mr. Fairbairn made himself unofficial host, at least as soon as the train connected with the Canadian Pacific System. His private car was placed at the convenience of all the special party, and many were the guests he entertained. At every stopping point he was the leader among the sightseers, and no one had occasion to complain of lack of attention.

To return to his work for the Canadian Pacific Railway, he saw to it that concrete construction was adopted for many of the structures. He was responsible for the construction of the Lethbridge Viaduct and of the Lachine Bridge, as well as for strengthening many other right-of-way structures. Under his supervision also fell the improvement and extension of the road's extensive

hotel system, which is praised by discriminating travelers throughout the world.

Then there were the rail terminals at Quebec and Montreal, which he handled. He collaborated also on those at Winnipeg and Vancouver, the latter an ocean terminal. Under him the building and improvement of the 5-mile Connought Tunnel took place. When Toronto was constructing its Union Station and Viaduct, Mr. Fairbairn acted as consulting engineer for the Toronto Terminals Railway, with responsibility for grade separation and other extensive operations. His also was the responsibility for construction of the Royal York at Toronto, the largest hotel in the British Empire, as well as for extensions on the Banff Springs and Chateau Frontenac hotels.

It goes without saying that Mr. Fairbairn has acquired an enviable reputation for the soundness and breadth of his engineering work. Second only to this is the personal regard in which he is held by everyone who knows him, whether professionally or socially. His fine personality is compounded of an imposing appearance and a gracious manner, which mark him the distinguished gentleman he is known to be.

He is "exhibit No. 1" in proving the truth of the adage, "a sound mind in a sound body." He is physically one of the soundest men for his age that could be found. Perhaps this is due to the cold baths he takes every morning summer and winter, with the subsequent vigorous rubdown and massaging in front of an open window. Or perhaps it is the cause of, or the result of, the fact that he is an enthusiastic and excellent swimmer. Those who live near his summer residence, as well as his family, are well aware of his fondness for wearing shorts.

If you wish to get him started and have a little time to listen, simply ask him about his grandchildren. Each one of the six is his "pal," and they reciprocate his comradeship.

Another great enthusiasm is his summer home at Juniper Island, Stoney Lake, Canada. This estate has been in his family for a great many years and is one of the best islands in the lake. He and Mrs. Fairbairn relish the fact that their home is a community center for all the members of the family. All summer long the various sons and daughters come with their families and add to the gaiety. One of the features of the island is a very fine concrete dock, built almost entirely by Mr. Fairbairn himself. He it was who made the forms, mixed the concrete, and placed it. His friends keep referring to this work as one of the principal accomplishments of his career.

Not that his more substantial recognition in the field of engineering has been overlooked. Quite the contrary—he has been president both of the Engineering Institute of Canada and of the American Railway Engineering Association.

His social activities are not his only interest. For years he has been a camera enthusiast, spending much time and money on moving pictures. His retirement has given greater scope to this hobby. Still more recent is another hobby that has perhaps overshadowed the others, motor-boat racing—a sport that has taken a strong hold on him within the past two or three years. He now owns a very fine boat which he takes great pleasure in running. This love of boating he shares with the other Honorary Member of the Society from Canada, George H. Duggan.

In brief, J. M. R. Fairbairn is an outstanding man, and an illustrious engineer. He will reflect credit on his new affiliation as Honorary Member of the Society.

HENRY SYLVESTER JACOBY

TO A GENEALOGIST of note, such as Henry Sylvester Jacoby, doubtless the most desirable form of life history consists of tracing the various branches of a family tree back to its source, or vice versa. This would be a fascinating research, as Mr. Jacoby himself has discovered, but it would hardly satisfy the present purpose.

In justice to Mr. Jacoby's family tree, however—it must be recorded that his earliest American forebears, Peter and his wife, Maria Elizabeth Heuer Jacoby, arrived in Philadelphia from Germany with two young children in 1741. They settled in the adjacent Bucks County and became strongly identified with the agricultural, business, and religious life of the Pennsylvania German community. The family, or at least important parts of it, remained in this section, for there Henry Sylvester Jacoby was born in 1857.

Not far from Bucks County to the north is Bethlehem, Pa., seat of Lehigh University, the nearest technical institution, to which young Jacoby was naturally attracted. He attended the preparatory department and then the university, from which he graduated in civil engineering in 1877. Part of his vacation periods had been spent in surveying and allied work, and this same type of service in his home town engaged him following graduation. This naturally led to employment on the Mississippi River Survey, where he spent over six years, the last five as chief draftsman in the U.S. Engineer Office in Memphis. A year of merchandising followed his river work, after which he settled into his lifetime vocation of engineering teaching.

HENRY SYLVESTER JACOBY

It was in the fall of 1886 that he became an instructor at Lehigh. After four years he transferred to Cornell as assistant professor, and there he remained for over thirty years, twenty-two of which were spent as professor of bridge engineering. He is now professor emeritus.

During all these years he has devoted much time to the writing and revision of engineering textbooks, which have had a wide popularity. Some of these, particularly those published before the present century, were written in conjunction with the late Prof. Mansfield Merriman, M. Am. Soc. C.E., under whom he worked at Lehigh University. Still others were wholly his own. More recently he has collaborated with Dean R. P. Davis, M. Am. Soc. C.E., one of his former students at Cornell. Many of these texts have gone through a number of revisions. He has also written widely for engineering periodicals.

His leadership in the field of education has been recognized by membership and office in the Society for the Promotion of Engineering Education, of which he was secretary and later president; in the American Society for Testing Materials; and in the American Association for the Advancement of Science, of which he was secretary and chairman of one section. Numerous other alumni and local engineering societies have claimed his membership—for example, he was elected honorary member of the Washington Society of Engineers. Other affiliations are with the honorary societies Sigma Xi and Tau Beta Pi. Professor Jacoby has had no lack of recognition in the engineering field.

It is hard to see how one man could have so great an output of valuable work to his credit. The answer is that Professor Jacoby has never been willing to mark time. When he graduated from Lehigh University in 1877 he realized that his engineering course had been narrower than he desired in the range of its contents. A year after graduation there came to his attention an address delivered by Dr. John H. Vincent, forecasting the Chautauqua studies that later became so well and widely known. Feeling that such a course of systematic reading in cultural subjects was just what he needed to continue his education, he enrolled for the four-year course, in history, literature, art, and science, and completed it in 1882. Later he took several special courses.

It was during his Chautauqua studies and while he was still a young man that he received a circular dealing with the classification and systematic preservation of various articles. This led him to adopt a practice which was to mean much in his later professional life. He secured a copy of Dewey's *Decimal Classification*, of almost 600 pages, and began to make an extensive collection of clippings, manuscript memoranda, and references to periodicals for tens of thousands of articles. This practice of systematically indexing data proved to be of incalculable value to him in the preparation of his textbooks on bridge engineering for college students.

Every one of Professor Jacoby's former students should remember how effectively he used written instructions both in recitation

work and in design. For each course, he prepared a printed syllabus, giving the dates and contents of every exercise throughout the semester. For recitation courses there were 3 by 5-inch cards containing a set of questions on each day's work. These saved a great deal of time in giving out questions and problems, and also ensured a complete coverage of the day's work. His written instructions for design courses were models of completeness and conciseness.

Although Professor Jacoby did practically no consulting work during his teaching days, few practicing engineers were better informed on the progress of the art and science of engineering. He used to spend his sabbatical leaves traveling throughout the United States and Canada. One such trip covered over 23,000 miles, and included interviews in over 100 departments of railroads and municipalities. In addition he talked to 120 engineers in private practice scattered throughout 48 cities. Not only his own students, but those reading his textbooks profited from this habit of his. As a result his students became authorities in the structural field throughout the country, and his preeminence as an educator attracted young men from far and wide, even from foreign shores. Just before his retirement he had ten Chinese students enrolled for graduate work.

From his background of God-fearing ancestors, he acquired a strongly religious nature. He has been very active in Sunday School work. His efforts in the cause of religious education include 16 years of service as president of the Tompkins County, N.Y., Sunday School Association, and 21 years as a member of the executive committee of the New York State Council of Religious Education, 7 years as chairman.

His standing in the field of genealogy has been noted. This interest was kindled early in life—he began selecting genealogical information when he was eighteen—and continued as an avocation over a period of many years. Finally it resulted in the writing and the publication in 1930 of *The Jacoby Family Genealogy*, a book of some 675 pages. Professor Jacoby is a member of many historical and genealogical societies and was president of the National Genealogical Society for five years.

Most professors dread the approach of the day of retirement. Not so Professor Jacoby; he looked forward to being relieved of the daily routine so that he might be free to follow his own interests. When he became professor emeritus in 1922 he moved from his long associations in Ithaca to Washington, D.C., so that he might have the facilities of the Library of Congress for carrying on his genealogical and other studies. Today, at the age of 82, this elder statesman of the profession has all the enthusiasm and interest in life that would do credit to a young man.

One naturally asks, what attributes in a man are responsible for his establishing a reputation in such diverse fields as professional engineering, education, technical writing, religion, and genealogy? In the case of Professor Jacoby, three outstanding characteristics have made success inevitable—capacity for hard work, systematic habits, and outstanding thoroughness. Something of his philosophy of life and of his studied practice appears in the preface of his *Jacoby Genealogy:*

"The usefulness of one's life as well as its joy have been considerably enlarged by the achievements of others before we were born. The most effective way in which we can repay this debt is not simply to appreciate what they did, but to work in turn for others either now living or not yet born. Only thus is the torch of knowledge and influence handed on from generation to generation."

The profession recognizes these ideals and accomplishments in singling out this man for honorary membership in the national society of his chosen profession.

THOMAS ULVAN TAYLOR

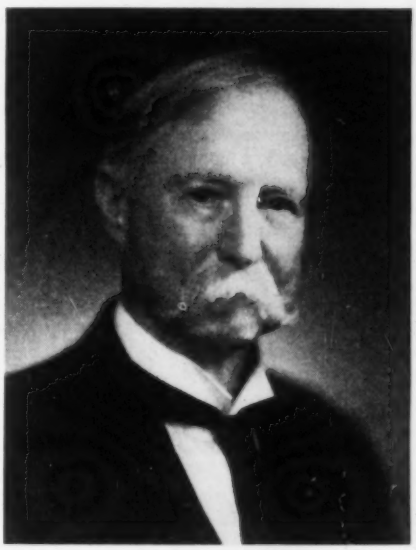
ANYONE who is up early enough on the campus of Texas University in Austin can spy out a vigorous old gentleman with a white walrus mustache energetically striding across to the engineering building to meet a permanent seven o'clock appointment. Asked to identify him, a student will quickly state that it is "T. U.," or "the old man." The fact is, he has been "the old man" for many decades and his synonym, "T. U.," identical with that for the university, has been his nickname since the earliest "old grad" can remember.

What brings him out so early? True, he has been retired for a number of years and he could just as well take things easy. Not T. U. Taylor; he insists on meeting a class of students from 8 till 9 in the morning and what is more, on holding office hours from 7 until 8. And this means that he gets there at 7—no tardiness for him. He gets up early, prepares his own breakfast, and is out on the street in time to see that the milkman and the newsboy get their jobs done properly.

It is not so difficult to understand that vigorous personality, Thomas Ulvan Taylor, when one realizes the circumstances of his birth 82 years ago and his subsequent upbringing. He was born in Parker County, out on the Texas frontier, where Indians were a reality and not merely a myth. His father died when he was 10, leaving to him the responsibility of helping his mother. But this did not discourage him. He received his earliest education in the open air under a tree against which the boys were wont to stack their rifles, carried always as a protection against Indian attack.

During this period he made several trips with his father and other men who were transporting freight east to Jefferson, Tex., the headquarters of navigation of that day. The Mississippi boats would come up the Red River and through Caddo Lake to Jefferson, there to discharge the overland freight and take on new cargo. This was a romantic life for young Taylor.

Sometimes he made trips in another direction to meet the advancing Houston and Texas Central Railroad then being extended north toward Dallas. Dean Taylor still enjoys telling the story of one of the luxury trains, a special conveyance prepared to grace a gala occasion in a frontier town. The train consisted of flat cars with benches for seats, on one of which sat a rather large lady holding a parasol to shield her from the sun. As the train roared along at as much as 12 or 15 miles an hour, the youth thought that he was witnessing the height of luxury.



THOMAS ULVAN TAYLOR

When he was 12 years old he moved to Cleburne, Tex., and there obtained work in a brickyard, "trotting bricks." In an effort to add to his meager income, he used to get up at four o'clock in the morning, to carry water from a distant spring to one of the saloons in town, at the rate of five cents a bucket. After that he could doubtless enjoy a good breakfast.

In 1879, the Sam Houston Normal opened its doors in Huntsville, Tex. T. U. Taylor won a competitive examination against eight others from his senatorial district and thus began his college studies. One of his instructors instilled in him an ambition for a more extended college education, with the result that he borrowed the necessary money. Meanwhile, friends had persuaded him to try the University of Virginia, from which he was graduated two years later with a degree in civil engineering. His fine record at the university brought him the offer of a teaching position in physics and mathematics at the Miller Institute, Crozet, Va., and there he stayed for five years.

But he could not resist the call of his native state and at the first opportunity made application at the University of Texas to teach engineering and freshman mathematics. When he started in 1888 there were 13 on the faculty of the university and about 250 students. In 1895 the department of engineering was created and he was made dean. This is the position that he held for 41 years. Since 1936 he has held the title of dean emeritus.

Literally thousands of students have come under his influence. It was not long before he was "the old man," and by this affectionate title he is known all over the Southwest. He has been especially interested in financing poor boys who must work their way through college. As witness the establishment, more recently, of the T. U. Taylor Foundation, now boasting several thousand dollars of investment funds.

One evening years ago, a few students told him of a certain undergraduate who was withdrawing; in fact he was starting home

that very night. Dean Taylor went to the depot immediately and demanded of the boy why he was giving up. Then he found that the student's money was exhausted and apparently there was no other solution. The Dean finally persuaded the boy to stay, and then found ways of getting the necessary funds. That boy is now one of the leading water supply and hydraulic authorities in the country, with a nation-wide reputation.

Among the many traditions that cluster around Dean Taylor's name is that of the "Ramshorn." The Dean was in the habit of marking a perfect paper in his courses with a check, which mark in time accumulated a long flourishing tail, for which the students found the nickname, "ramshorn." That's what a perfect paper means at the University of Texas. When Dean Taylor completed 25 years at the university in 1913, the first man to have served for this length of time, it was decided to hold a big celebration. As one feature the Dean provided every former student with a brass watch fob, inscribed on the face with "The Old Man's Engineers—1888–1913" and embellished with a graphic ramshorn.

In the early days of his teaching, membership in the Society held great attractions for T.U. but at the same time great difficulties. He could not find five corporate members to serve as references. Perforce he had to look elsewhere for a solution. So he went to Kansas City and worked for two months in the office of the late J. A. L. Waddell, later an Honorary Member of the Society. There he met enough engineers to give him the necessary references. Thus he joined the Society.

During his teaching he has written extensively—textbooks, handbooks, technical articles for the press, and articles for professional societies. His paper on "Silting of the Lake at Austin, Tex.," was printed in TRANSACTIONS, Vol. 93. In that subject and similar ones he has been greatly interested in his later years. He has also served in a consulting capacity on water improvements, structural engineering, reclamation, and similar matters, mostly among the larger cities of Texas and in the Southwest.

Many years ago he purchased his first and only automobile. What automobiles there have been in the family since then have belonged to Mrs. Taylor. Although his one car is now somewhat legendary, a certain experience it evoked is still graphically remembered. Members of the faculty decided they would put on an evening social program centered around a trial at which Dean Taylor was charged with "auto intoxication." This did not appeal greatly to the Dean, so he called nine boys to his office and told them what they were expected to do. At a critical period in the trial and upon a prearranged signal, the nine descended upon the meeting, fitted out with pistols and cowboy garb. In true Wild West style they discharged their firearms, rushed the faculty club, and rescued the Dean from the imposition of the trial. Much realism was put into the exhibition, giving the party and particularly the other faculty members an unexpected thrill.

A word must be said regarding Mrs. Taylor. She has been a real partner in all the Dean's successes since their marriage 51 years ago in Virginia. During that time she has had to share him generously with the university, for that and his home, between them, have monopolized most of his activities.

They say he has as much "pep" as any youngster. Let him put on a freshman cap and he will lead the singing of "The Eyes of Texas" with gusto; or he will make 11,000 students roar as he leads cheers at the athletic rallies. He likes square dances, and is frequently called upon to lead them. Although he is 82 years old, he was recently asked to attend such a party and he started teaching a group how to "swing your partner." Next morning he seemed to be somewhat the worse for fatigue, and even confided to one of his confreres that he had been foolish to stay up so late. He added, however, that he would like nothing better than to try it again the next night.

His popularity will never die. He never forgets a student, even one who has been gone from the campus thirty years or more. He will recall student pranks and quips of yesteryear, and call the culprit by name. His boys, now scattered over the entire country, but mostly in the Southwest, are still strong for "the old man." Nothing, not even honorary membership in the Society, can give him a greater place in their hearts.

Juniors and Students Have Only Six Months to Complete Entries for Mead Prizes

JUNIORS and students are reminded that July 1, 1940, is the end of the first competition year for the newly established Daniel W. Mead prizes for the promotion of the study of ethics. Detailed rules governing the competition were published in CIVIL ENGINEERING for November 1939 (page 674), and the specific topics for papers were announced the following month (page 756). For Juniors, the topic is "Ethics for Sales Engineers"; for students, "Ethics for Engineering Students." In selecting these subjects, Dr. Mead intentionally went outside the field covered by the paper on "Standards of Engineering Relations and Conduct" which he is to present at the Annual Meeting of the Society and which will appear in the January issue of PROCEEDINGS. Thus broad possibilities for original thought and research are assured.

A word is perhaps in order on the connotations of the Junior topic. The "sales engineer" may be taken as an engineer who sells materials or equipment, or the engineering services of an industrial organization. In a larger sense it also includes the consulting engineer himself, in so far as he is concerned with promoting the business of his firm. It is intended that any or all of these interpretations may be put on the topic. Further, the ethics of the engineer buyer, in relation to the sales engineer, may be brought into the discussion in a subordinate way. It is realized that only a small number of Juniors are actually engaged in any of these activities, but it is not intended that this should deter any from entering the competition. The perspective of a man not in sales work may reveal aspects of the topic not evident to one immersed in it. Moreover, ability to analyze the problems of a field other than his specialty is an important attribute of the engineer.

According to the rules, competing papers must be less than 2,000 words in length and must be presented before a Local Section, a Local Section conference, a Student Chapter, or a Student Chapter conference. "Local Section" is interpreted to include any Junior group sponsored by a Section. All papers must be in the hands of the Secretary of the Society by July 1, 1940.

Who Works for the Society?

MORE THAN 4,500 members of the Society have contributed of their time and services to the advancement of its work during the past year, according to a study recently made at the headquarters office. About 3,600 of these were members of committees, while the remaining thousand functioned as individuals.

To begin with, there are the 36 "Society Committees," with a total personnel of 116. Many of these are listed on page 9 of the current Year Book. Next come the 57 committees, technical and administrative, on which the Society is represented jointly with other organizations. Eighty-eight members are currently assigned to this work.

The 12 Technical and Functional Divisions of the Society list a total of 74 committees, with 414 members (omitting duplications). Then, under the "miscellaneous" classification, are 235 committees with 869 members. These groups include the local membership and Junior membership committees and the local committees on Society meetings. Finally, in the 63 Local Sections there are 588 committees with a personnel of 2,080.

Individuals contributing to the work of the Society comprise 547 authors and discussers of papers in CIVIL ENGINEERING (12 issues) and PROCEEDINGS (10 issues), and approximately 500 reviewers who have prepared reports on papers for the study of the Committee on Publications.

Thus it will be seen that of the 15,000 men wearing the badge of the Society, about three out of ten had some personal part in its activities during 1939. For some it may have been a matter of only a few hours; for others, the time contributed voluntarily and without recompense can be measured not in hours but in weeks.

ANNUAL MEETING of the Society, to be held in New York, N.Y., January, 17–20, 1940

Certificates to 138 Life Members of the Society

ONE HUNDRED THIRTY-EIGHT new names were added to the list of Life Members of the Society on January 1, 1940, in accordance with the constitutional provision applying to those who are 70 years of age and have paid dues as Corporate Members for 25 years, and to those less than 70 who have paid dues for 35 years. The list appears below.

In addition to being exempted from dues, Life Members are given recognition in the form of a certificate signed by the President and the Secretary of the Society. In a number of Local Sections, a special ceremony is made of presenting these certificates. Where no such programs are planned, the certificates are mailed direct to the recipients from Society Headquarters.

MEMBERS BECOMING EXEMPT FROM PAYMENT OF DUES AS OF JANUARY 1, 1940

Allen, Eugene Yorke
Armstrong, Alexander Floyd
Armstrong, Walter Root
Austin, Frank Willis
Beattie, Roy Hamilton
Beer, Paul
Begien, Ralph Norman
Berry, Thomas
Blanchard, Arthur Horace
Bonnyman, Alexander
Bradshaw, Charles
Brosius, Albert Marshall
Brown, William Gerrie
Brush, William Whitlock
Burdick, Charles Baker
Carlin, Joseph Patrick
Cattell, William Clark
Clapp, Sidney Kingman
Clapp, Wilfred Atherton
Clausen, Jacob Centennial
Cochrane, Victor Hugo
Cole, Harry Outen
Colpitts, Walter William
Congdon, John Potter
Darrow, Wilton Joseph
Davis, Francis Hewette
Domenech, Manuel Victor
Doty, John Williams
Eckart, Nelson Andrew
Enzian, Charles
Falk, Myron Samuel
Fauntleroy, James Dearing
Foote, Arthur Burling
Forchhammer, Herluf Trolle
Galloway, John Debo
Gault, Homer Johnston
Giesecke, Frederick Ernest
Goodrich, Ernest Payson
Gordon, John Blake
Grady, Charles Benedict
Greenwood, Albert Henry
Griswold, Howard Clifton
Hager, Albert Bertram
Haupt, Edward
Henderson, Samuel Whilden
Holbrook, Frank Dudley
Holden, Charles Arthur
Hotchkiss, Louis Jenison
How, Richard Willis
Howard, Ernest Emmanuel
Hudson, Harold Walton
Hughes, John Wilbur
Hunt, Charles Adams
Hyatt, Caleb
Inagaki, Hyotaro
Jansen, Edward Clinton
Johannesson, Sigvald
Jordán, Ricardo Tomás
Keefe, David Andrew
Kimball, Herbert Sawyer
Kirchner, Paul Alois
Kornfeld, Alfred Ephraim
Lane, Harry Alfred
Leake, Boudinot Gage
Leland, Ora Miner
Lewis, John Howard
Lindsey, Kieffer
Lobo, Carlos
Lochridge, Elbert Emerson
Lowe-Brown, William Lowe
Lytel, James Leonard
Machen, Henry Bennett
Mack, Edward R.
MacMartin, James MacGregor
McDaniel, Allen Boyer
McMurtry, Guy
Mair, John William
Manchester, Ernest James Theodore
Marshall, Robert Albertsen
Meadowcroft, William
Mees, Curtis Adolph
Mensch, Leopold Jehud
Moorshead, Thomas Courtney
Morris, Lardner Vanuxem
Nelson, Alexander Howard
Nichols, Walter Swain
Norcross, Joseph Arnold
Norris, Walter Henry
Oakes, Luther Stevens
Older, Clifford
Owen, Arthur Edmund
Parker, Robert Preston
Parks, Oren Elisha
Patten, William Nickels
Paul, Charles Howard
Peabody, William Welcome
Pelz, Carl Edouard
Penfield, William Henry
Potts, Clyde
Proctor, Lewis Jefferson
Proctor, Ralph Fenno
Reed, Howard Sawyer
Riedel, John Charles
Rockwell, Edward Henry
Russell, Samuel Moorhead
Sargent, Arthur Winthrop
Saunders, George Crosby
Sawyer, Wilbur Cyrus
Scherer, George Cheever
Searle, Charles Depew
Sewell, John Stephen
Shanks, Oscar
Shaw, Frank Harold
Sheldon, Charles Smith
Sherman, Henry John
Sherman, LeRoy Kempton
Silva Freire, Victor da
Sitt, William Theodore
Smith, George Edson Philip
Stewart, John Wellington
Straub, Theodore Alfred
Swendsen, George Lewis
Taft, Jesse Russell
Taylor, Edwin Alexander
Terry, John Hermon
Thompson, Wilford Ashford
Thurber, Clinton Draper
Tooker, Francis Westervelt
Torrey, James Eaton
Tull, Richard William
Wait, Owen Adelbert
Waite, Henry Matson
Wauters, Carlos
Webb, De Witt Clinton
White, Gilbert Case
Widdicombe, Robert Alexander
Woodward, Edwin Carlton
Wooten, William Preston

San Francisco Section Sponsors Courses in Advanced Study

SUCCESSFUL in its first efforts to promote evening courses in specialized engineering subjects, the San Francisco Section now intends to establish its Committee on Advanced Study as one of the regular standing committees of the Section.

The project was initiated in the fall of 1938 at the request of a number of members, who pointed out that college courses now include a number of subjects such as soil mechanics, photoelasticity, and engineering economics, that the engineer now in practice was not privileged to take during his undergraduate days. The board of directors of the Section accordingly appointed a committee to study the possibilities and proceed with plans.

As the first step a questionnaire was sent to all members of the Section, asking them to state the specific subjects of special interest to them and their preference as to the type of course (lecture series, technical discussion group without instructor, correspondence course, class with instructor, and so forth). Other pertinent questions included the following: Is your interest dependent on university credit? Are you interested in special preparatory courses for licensing examination? Could you attend classes two nights per week, one night per week, Saturday afternoons, or summer session? Are you willing to pay a fee ranging from $5 to $10 for each course?

"The response to this questionnaire was gratifying," writes T. J. Corwin, Jr., secretary of the Section. "The next problem was to coördinate the answers. As a result of this analysis, courses were announced in soil mechanics and engineering economics. The courses were held weekly on the Berkeley Campus of the University of California, and were well attended. A course in advanced structural analysis has also been announced, but postponed for the present because of the inability of a sufficient number of those interested to meet at the same time."

Chairman of the Committee on Advanced Study is Morrough P. O'Brien, and the members include Earl M. Buckingham, John Hedberg, Augustus V. Saph, Jr., and E. M. Shanley. "Their work is deserving of great praise," continues Mr. Corwin. "This is certainly a new field in which the Section can assist the members in advancing in their profession."

Appointments of Society Representatives

ROGER W. ARMSTRONG, M. Am. Soc. C.E., has been appointed to represent the Society on the J. Waldo Smith Hydraulic Fellowship Committee, filling the vacancy caused by the death of the late THADDEUS MERRIMAN.

JOHN H. BRINGHURST, M. Am. Soc. C.E., served as the Society's delegate at the ceremonies in connection with the inauguration of Homer Price Rainey as president of the University of Texas on December 9 at Austin, Tex.

JOHN P. HOGAN, M. Am. Soc. C.E., will be one of the Society's representatives on American Engineering Council for the year 1940.

THOMAS H. WIGGIN, M. Am. Soc. C.E., has been appointed to represent the Society on the Freeman Traveling Scholarship Committee.

Construction-Engineering Prize to Howard L. King

SELECTION of Howard L. King for the first award of the Construction-Engineering Prize was announced by the Executive Committee of the Society at its meeting on December 9. Presentation will be at the opening session of the Annual Meeting on Wednesday morning, January 17.

The prize was established in 1939 through the initiative and generosity of A. P. Greensfelder, M. Am. Soc. C.E., and may be given annually for the best original scientific or educational paper on construction published in CIVIL ENGINEERING. It is the only prize specifically limited to material appearing in that publication.

Under the rules approved by the Board of Direction last April and announced in the June issue, the award is made on recommendation of the Executive Committee of the Construction Division, followed by approval by the Board of Direction. Construction papers eligible for the 1939 award were those published between August 1938 and July 1939, inclusive. Mr. King's paper, "Subaqueous Tunnel Construction," appeared in the March 1939 issue.

Now chief engineer of Mason and Hanger Company, Inc., Mr. King has devoted most of the 24 years of his engineering career to tunnel construction. From 1915 to 1917 he was in the engineering department of the Public Service Commission of New York City, on the East River Tunnels. From 1921 to 1928 he was on the engineering staff of the New York and New Jersey bridge and tunnel commissions, on construction of the Holland Tunnel, and was resident engineer on the Jersey side when the work was completed. Since 1928 he has been continuously with Mason and Hanger—first on the Fulton Street Tunnel, next on the Rutgers Street Tunnel (both under the East River), and still later on the Midtown Hudson Tunnel. He is a graduate of the College of the City of New York (A.B., 1908), Columbia University (A.M., 1912), and Massachusetts Institute of Technology (S.B. in civil engineering, 1915).

Alfred Noble Prize to Electrical Engineer

CLAUDE ELWOOD SHANNON, Associate, American Institute of Electrical Engineers, has been selected as this year's winner of the Alfred Noble Prize. The award will be made at the winter convention of the Institute in New York, the week of January 22, by a representative of the American Society of Civil Engineers, trustee of the prize fund.

This prize was established in 1929 in honor of the late Alfred Noble, Past-President of the American Society of Civil Engineers and of the Western Society of Engineers. It is open to members, below the age of 31, of either of those societies or of the A.I.E.E., the A.I.M.E., or the A.S.M.E., and is awarded for technical papers of exceptional merit. Mr. Shannon's contribution was "A Symbolic Analysis of Relay and Switching Circuits," published in *Transactions*, A.I.E.E., in 1938.

Mr. Shannon is 23 years of age. In September 1936 he became research assistant in the department of electrical engineering at Massachusetts Institute of Technology, and two years later was appointed assistant in the department of mathematics there, working on applications of certain branches of mathematics to electrical engineering and to other subjects.

Papers Filed in Library

ANNOUNCEMENT is made that the following papers have been contributed to the Society for filing with the Engineering Societies Library, 29 West 39th Street, New York, N.Y. Charges for photostating will be quoted by the library on request.

FLOOD FREQUENCIES

FOSTER, EDGAR E., Assoc. M. Am. Soc. C.E., "Flood Frequencies by the Theory of Probability" (39 typewritten, double-spaced pages, plus one diagram). This paper, the author states in his synopsis, "traces the growth of the application of the mathematical theory of probability to the problem of flood frequency and presents by means of an example, fully worked out, several methods of calculating frequencies by that theory. It is pointed out that a logarithmic function of the variation of magnitude is necessary to handle the extreme skew of flood data and that two such functions have been developed which can be used with satisfactory results."

TEHUANTEPEC CANAL

PEIMBERT ANGEL, late M. Am. Soc. C.E., "Studies Relating to the Construction of an Interoceanic Ship Canal Across the Isthmus of Tehuantepec" (translated from "Revista Mexicana de Ingeniería y Arquitectura" by Carlos Helmus, in cooperation with Wallace E. Belcher, M. Am. Soc. C.E.; 32 typewritten double-spaced pages plus 4 sheets of maps and drawings). "Mr. Peimbert," says Mr. Belcher in his introduction, "spent the greater part of his life in the development, construction, and operation of the Tehuantepec railroad. . . .It was his opinion that as the Panama Canal traffic approached the limit of its capacity, the Isthmus of Tehuantepec offered the most advantageous location for a second canal, feasible from an engineering standpoint and financially profitable. . . .Because of his eminent qualifications, it is considered that the record of his studies in connection with the canal should be made available in English." The canal, as envisioned by Mr. Peimbert, would include a ship tunnel 50 meters in diameter and 31,250 meters in length. His estimate of the total construction cost of tunnel, locks, main canal, and port reconditioning was $327,000,000 (U.S.).

CONTINUOUS ARCHES

SCHAFFEL, F. L., Jun. Am. Soc. C.E., "Analysis of Continuous Arches on Elastic Piers" (37 typewritten, double-spaced pages, plus 3 sheets of calculations and diagrams). The object of this paper is "to expand the slope-deflection method" to curved and straight members of varying cross section and "to apply the method to the solution of a system of continuous arches on elastic piers." The example chosen for detailed analysis is a system of three equal symmetrical arches on two equal piers. The treatment is purely analytical, no attempt having been made to extend the analysis to actual design.

PANAMA CANAL TOPOGRAPHIC SURVEYS

SHELDON, R. C., Assoc. M. Am. Soc. C.E., "Topographic Surveys for Enlargement of the Panama Canal" (12 typewritten, double-spaced pages). This paper describes the methods used in mapping various areas in the vicinity of the Canal following the authorization of the enlargement program. The maps are to a scale of 1:1,000 and were controlled by triangulation and chain and stadia traverses.

TEMPERATURE STRESSES IN MONOLITHIC TRACK STRUCTURES

WALLACE, FELIX A., "Analysis of the Distribution of Temperature Stresses in the Monolithic Type of Concrete-Track Structures" (24 typewritten, double-spaced pages, plus 2 pages of diagrams). In this type of structure the rails, with thermit-welded joints, are embedded in a continuous concrete slab. According to the author, design of such structures to resist temperature stresses "has been to a large extent dependent on the past individual experiences of the designers." He presents an analytical method, with the hope "that it will stimulate interest and further progress in this problem."

British Ambassador to Present Myddelton Cup Replica to Society

ON JANUARY 9, Lord Lothian, British Ambassador to the United States, acting on behalf of the Institution of Civil Engineers, will present to the Society a replica of the historic Myddelton Cup. The ceremony will take place at the Washington Hotel, in Washington, D.C., at a banquet for members and their wives arranged by the District of Columbia Section. Invitations to participate have gone out to all the nearby Local Sections and to all officers of the Society.

Presentation of the cup—originally planned as a highlight of the projected British American Engineering Congress last fall—is "in token of the friendly relations which have ever existed" between the Institution and the Society. When the outbreak of war put

an end to the Congress plans, the British engineers made arrangements through their foreign office for the ceremony just announced.

Program plans are being completed as this issue goes to press. A letter just received from the District of Columbia Section outlines them as follows: After the dinner John C. Page, Section president, will turn the meeting over to the toastmaster, W. E. Reynolds, past-president of the Section. Lord Lothian will then be introduced and will make the presentation address, with President Sawyer responding on behalf of the Society. Following this there will be an address by John Carmody, Administrator of the Federal Works Agency, and a short musical program.

The original Myddelton Cup was presented to Sir Hugh Myddleton in 1613 by the Worshipful Company of Goldsmiths of London for his services in providing London with a supply of potable water. It remained in the possession of the Myddleton family until 1922, when it was acquired by the Goldsmiths' Company. Many readers will recall having seen it on exhibition in the British Pavilion at the New York World's Fair. The replica, faithful to the form of the original in every respect, will be on display at Society Headquarters during the Annual Meeting.

More Regional Student Chapter Conferences

Carolina Conference of Student Chapters

Most of the regional Student Chapter conferences meet in the spring but the Carolina conference meets twice a year. Its fall meeting was held jointly with the North Carolina Local Section on the campus of Duke University, Friday and Saturday, October 27–28, 1939. Representatives were present from the Student Chapters at Clemson College, The Citadel, North Carolina State College, the University of South Carolina, and Duke University.

Friday afternoon was given over to the registration of students and inspection of the Duke Engineering Laboratories. The conference executive committee also held its preliminary meeting. In the evening the student representatives attended the Women's Pan-Hellenic dance.

The Section and Chapters got under way Saturday morning with the opening of the joint meeting by President Frank T. Miller of the North Carolina Section. After Dean William H. Hall welcomed the visitors on behalf of Duke University, the principal address was given by Prof. John D. Watson of Duke University on "The Importance of Good Foundations."

The meeting was then turned over to J. R. Liles, president of the Carolina Student Chapter conference, who conducted the prize competition. The North Carolina Local Section offers $30.00 in prizes for the best papers delivered at the Carolina Conference of Student Chapters when they meet in North Carolina. As the result of this competition, Phil Mitchell of Duke won the first award with his paper on "The Failure of the Fort Peck Dam." Second prize went to D. B. Kennedy of Clemson for his paper on "Design of Earthquake Resistant Structures." Third place was taken by E. H. Johnson of North Carolina State College for his paper on "The Development of Prefabricated Houses," while Stan Zynda, Citadel, was fourth with a paper on "Photoelastic Analysis." The committee of judges was composed of T. S. Johnson, North Carolina State College, H. G. Baity, University of North Carolina, and H. B. Gotaas, University of North Carolina. The awards were presented by President Miller of the North Carolina Section.

The prize competition was followed by a business meeting of the conference which then adjourned to attend the football game between Duke and Wake Forest.

In the evening the formal conference banquet was held, followed by engineers' open house. The Duke committee on arrangements was W. F. Groesbeck, president; Carl King, vice-president; Arthur Alpert, secretary; Prof. J. D. Watson, faculty adviser; and H. W. Kueffner, contact member, who are also the officers of the Duke Chapter. The conference officers are chairman, J. R. Liles of Clemson College; vice-chairman, E. H. Johnson of North Carolina State College; and secretary-treasurer, J. D. MacLauchlan of Duke University. The total attendance at the joint conference was 78, including 17 members of the Society and 61 students. Of the students, 23 came from Clemson, 4 from The Citadel, 13 from North Carolina State, and 21 from Duke University.

North Central Conference Organized

Two weeks later the Chapter at Ohio State University was host to the organization meeting of the North Central Conference of Student Chapters. Representatives from Chapters at the University of Louisville, Michigan State College, Case School of Applied Science, Ohio Northern University, University of Dayton, University of Cincinnati, West Virginia University, and Ohio State University were in attendance on November 10–11, 1939.

President Claude White of the Ohio State Chapter called the first session to order on Friday afternoon, November 10. The president of each Chapter introduced the representatives from his Chapter. Dean C. E. MacQuigg welcomed the group on behalf of the College of Engineering of Ohio State University and discussed engineering curricula and the effect of new social and professional conditions on the type of training necessary for the engineer. Prof. Clyde T. Morris, chairman of the department of civil engineering at Ohio State, former Director of the Society and now faculty adviser to the Ohio State Student Chapter, told how the conference came into being. This conference is of particular interest because it, together with the Texas Conference formed last spring, was the direct outgrowth of enthusiasm created at the Society's Chattanooga Meeting last April. Particular credit for instigating and carrying through the organization of the North Central Conference is due to the untiring efforts of Robert Lawson and Jack Matthaes, who had been the Ohio State representatives at the Chattanooga Meeting.

Prof. R. B. Wiley, chairman of the civil engineering department at Purdue and chairman of the Society's Committee on Student Chapters, was the principal speaker at the afternoon session. Professor Wiley described a program and objectives for a Student Chapter conference, illustrating the objectives by extracts from the annual reports of Student Chapters. For example, he quoted the objectives of the Chapter at the University of Dayton as being (1) to give its members experience in preparing, presenting, and discussing papers on technical and semi-technical subjects; (2) to afford contacts with engineers; and (3) to facilitate the initiation of its members into the engineering fraternity. He also quoted the objectives of the University of Illinois Chapter, which are (1) to acquaint the student with the practical phases of engineering and to develop a professional point of view; (2) to develop the fraternal attitude; and (3) to learn to conduct meetings.

Forecast for January "Proceedings"

Standards of Engineering Relations and Conduct

By Daniel W. Mead, Hon. M. Am. Soc. C.E. and Past-President Am. Soc. C.E.

A bible of practical ethics for the engineer in all of his contacts with the public.

Theory of Elastic Stability Applied to Structural Design

By Leon S. Moisseiff and Frederick Lienhard, Members Am. Soc. C.E.

Investigates the buckling resistance of plates or webs reinforced by stiffeners, and presents a method of design that will enable an engineer to utilize the higher buckling resistance of the reinforced plates to their full capacity.

Axioms in Roadway Soil Mechanics

By Henry C. Porter

A discussion of broad principles presented for discussion as axioms.

Chicago River Control Works

By H. P. Ramey, M. Am. Soc. C.E.

Construction details of the project for isolating the Chicago River from Lake Michigan and the Chicago Water Supply.

As to the conduct of a student conference, Professor Wiley listed four guiding principles: (1) that the conference should be run by the students themselves; (2) that the topics discussed should be of interest to students and if possible should be of a controversial nature, since such topics encourage discussion; (3) that the papers should be presented by students; and (4) that the form of the meeting should be similar to that of the Society's own meetings. He stated that the objectives of a regional conference are similar to those of a Student Chapter but are of wider scope and afford wider contacts. There is also a chance for Chapter members to learn how others solve problems similar to their own, and it also affords an opportunity to gain an insight into other philosophies of education.

Professor Wiley pointed out that any student activity must justify its existence and that it can best do so by affording the students an opportunity to acquire experience and make contacts not otherwise available through the regular curriculum. The principal objectives of an engineering curriculum are to provide sound technical training, to provide a wide background of knowledge (in which outside contacts can be a great help), to develop the ability to think clearly, to develop the imagination to conceive new ideas, and to develop articulateness, or the ability to talk and write. The ability to talk and write also holds the key to the ability to think clearly, since the thought process requires that we name the things we think about, and talking and writing provide these names by developing the vocabulary.

On Friday evening a dinner meeting was held with a total attendance of 92, including members of the Central Ohio Section. Music was furnished by a band composed entirely of students in the department of civil engineering and led by Prof. C. H. Wall of the department.

Following the dinner, Secretary R. B. Jennings of the Central Ohio Section introduced the members of his Section and expressed the Section's interest in student affairs. Professor Wiley, Professor Harding of the University of Louisville, and Professor Webb of Ohio Northern University were also introduced. The speaker of the evening was Field Secretary Jessup, who described the organization of Society Headquarters to conduct the business of the Society, described the difference between the engineer and the artisan, and told about some of the more interesting activities of Chapters with which he had come in contact.

For example, the Chapter at Oregon State has established a student loan fund; the Chapter at Iowa State invites the Iowa Section to meet with it; another Chapter buys up the student badges of its graduates and re-sells them at a profit to new Chapter members; while a fourth Chapter has instituted a plan whereby its members regularly set aside funds throughout their years in college to pay their entrance fee as a Junior in the Society upon graduation.

On Saturday morning there was an inspection of the laboratories and other buildings, followed by a luncheon. The official organization meeting of the new conference was then held. A constitution was adopted for the conference. The invitation of the Chapter at the University of Cincinnati was accepted to hold the next conference meeting in conjunction with the Fall Meeting of the Society in Cincinnati in October 1940. The officers for the conference were elected for 1940 as follows: chairman, Charles R. Nuckolls, University of Cincinnati; vice-chairman, Claude White, Ohio State University; and secretary-treasurer, Hugh Smith, University of Dayton.

This account of the North Central Conference Meeting was condensed from a report prepared by Charles H. Kruse and Lewis R. Skelton of the Ohio State Chapter.

Metropolitan Section Participates in City Planning Award

FIRST AWARD of a medal "for distinguished contribution to the plan of the City of New York" was made to George McAneny, president of the Regional Plan Association, Inc., at a dinner in New York on December 4, 1939.

The award is a joint undertaking of the Metropolitan Section of the American Society of Civil Engineers with three other organizations—the New York and Brooklyn chapters of the American Institute of Architects and the New York chapter of the American Society of Landscape Architects. It is intended "to encourage the planning of the metropolitan area of New York City, for the enhancement of its natural beauty and for the well-being of its citizens." William McK. Griffin, Leslie G. Holleran, and Harold M. Lewis represented the Metropolitan Section on the committee of award.

Foundation Names New Chairman

AT A MEETING of the executive committee of the Engineering Foundation, held November 28, 1939, Dr. O. E. Buckley, executive vice-president of the Bell Telephone Laboratories, New York, was announced chairman of the Foundation, to succeed George E. Beggs, M. Am. Soc. C.E., who died on November 23, 1939. F. F. Colcord, vice-president and manager of metal sales of the U.S. Smelting, Refining and Mining Company, New York, was elected vice-chairman to succeed Dr. Buckley. Other members of the executive committee are A. L. Queneau, Metallurgist of the U.S. Steel Corporation, New York; and W. I. Slichter, professor of electrical engineering, Columbia University.

K. H. Condit was elected to the chairmanship of the Foundation's Research Procedure Committee. Dr. Buckley becomes a member ex-officio; and E. M. T. Ryder, Way Engineer, Third Avenue Railway System, New York, was appointed to fill a vacancy on the committee.

Dr. Buckley is best known in the engineering world for his pioneering work on high-speed submarine telegraph cables. He had direct charge of the application of permalloy tape loading, and the development of terminal equipment which increased the carrying capacity four-fold. He is a fellow of the American Institute of Electrical Engineers.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies in 40 States

A.E.C. OFFICERS FOR 1940 NOMINATED

Candidates for offices of American Engineering Council to be filled at the Twentieth Annual Assembly, to be held January 11–12, 1940, in Washington, have been selected by the official nominating committee, as follows:

For president (two-year term): Alonzo J. Hammond, (Am. Soc. C.E.), consulting engineer, Chicago, Ill.

For vice-presidents (two-year terms): Colonel Donald H. Sawyer (Am. Soc. C.E.), Public Buildings Administration, Federal Works Agency, Washington, D.C.; and William L. Batt (A.S.M.E.), president, SKF Industries, Philadelphia, Penna.

For treasurer (one-year term): Leonard J. Fletcher (A.S.A.E.), assistant general sales manager, Caterpillar Tractor Company, Peoria, Ill.

C. O. Bickelhaupt (A.I.E.E.) and John S. Dodds (representing the state and local members of Council) are the other two vice-presidents, whose terms do not expire until 1941.

JOINT COMMITTEE STUDYING FUTURE OF A.E.C.

ORGANIZATION of the special joint committee formed to consider the future form and scope of American Engineering Council took place at its first meeting, held November 27 in New York City. The group, appointed at the suggestion of Council's president and executive committee, includes three representatives of each of the three Founder Societies that are Council's chief supporters—the American Society of Civil Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers—plus three men representing A.E.C. All members were present and, in addition, Council's President William McClellan and Secretary F. M. Feiker.

The meeting opened with a statement by Dr. McClellan outlining the background leading to the call for formation of the committee. He discussed the need for professional unity among engineers and the necessity for having some interprofessional body to

advance the public understanding of the profession of engineering, with special reference to the part that engineers should play in solving social and economic questions upon which they are peculiarly qualified to advise. American Engineering Council, he pointed out, is not a super-organization, but a functional service group for its members that is devoted to public service rather than to the specialized technical and engineering problems of the respective engineering societies. This membership now comprises over 50 national, state, and local technical organizations. In the last five years the number of state and local members has doubled.

Dr. McClellan then reviewed the constant difficulties experienced in financing the work of A.E.C., in keeping the rank and file of member societies informed as to its accomplishments, and in meeting the many opportunities for service presented to Council, many of which must of necessity be deferred because of lack of funds. He expressed the hope that the committee would consider these questions carefully from the long-range point of view, and suggested the organization of subcommittees to take up various phases of the whole problem.

A lengthy discussion followed, from which there emerged a number of major ideas that may be summed up as follows:

1. Some organization is essential, similar in character to the American Medical Association and the American Bar Association, to work toward the dual objectives of interprofessional relations among engineers and a combined professional approach to public problems.
2. The present American Engineering Council represents one method of providing such a body.
3. There should be closer coordination between the activities of American Engineering Council in its specialized public relations field and the various committees of its member organizations set up for similar or coordinate objectives such as, for example, the general advance of professional standards and the economic status of engineers, and interrelations between education and engineering.
4. The engineering profession as a whole has yet to find a means of advising the younger engineers on questions involving their future professional status.

The committee then organized, electing Dr. John C. Parker (A.I.E.E.) chairman, and T. F. Barton (A.I.E.E.) secretary. Three subcommittees were authorized to consider questions of membership, scope, and finance, and to be headed, respectively, by Malcolm Pirnie (Am. Soc. C.E.), Harold M. Lewis (Am. Soc. C.E.), and John S. Dodds (A.E.C.) To meet the immediate financial situation it was recommended that each of the three Founder Societies contribute not less than $8,300 to A.E.C. during the year 1940. The meeting then adjourned, at be reconvened at the call of the chairman.

Program Shaping Up for A.E.C. Annual Assembly

While the full program for the Twentieth Annual Assembly of American Engineering Council, to be held in Washington January 11-12, 1940, is not yet ready for announcement, acceptances already received indicate that the high standard of interest set by previous meetings will be fully equaled, if not exceeded.

One prominent speaker will be John M. Carmody, Administrator of the new Federal Works Agency, who ranks as one of the highest engineers in the federal service and who has charge of a large proportion of the government's public works program. Another will be A. C. Shire, of the U.S. Housing Authority, who will discuss the highly important subject of government fees for engineering services. Otto S. Beyer, a member of the National Mediation Board, will be a third, dealing with the timely question of adjustment of labor difficulties. Additional speakers will be announced later.

Committee reports to be presented will be of unusual importance, and will include the results of the year-long study of the patent system, sponsored jointly by A.E.C., the National Association of Manufacturers, and The Conference Board, as well as the first nation-wide symposium dealing with the activities of engineers in the public welfare.

Conference Discusses Building Problems

Representatives of all branches of the building construction industry met in Washington in November, under the sponsorship of the Chamber of Commerce of the United States, for a discussion of present problems. Major topics touched upon included apprenticeship problems, better standards for residential construction, markets for small homes, financing residential construction, the need for non-residential buildings, the modernization of industrial plants, and the effects of war upon construction. Copies of papers on these subjects are available from the Chamber at Washington, D.C.

One of the high lights of the meeting was a talk by E. P. Palmer, of Senior and Palmer, New York City, taking issue with the "gloomy hypothesis" that the American system of free and private enterprise is on the way out. He based his refusal to accept such a view upon four counts: (1) that no person, or group has enough knowledge of the complex economic, social, and psychological forces bearing upon the issue to make predictions with any degree of accuracy; (2) that "again and again in the past . . . prophets of stagnation have spoken their piece and have been wrong"; (3) that the lack of territorial frontiers will be countered by advances on the "interior frontiers of modern industry," better living standards; (4) that an admitted slowing down of the rate of population growth does not necessarily mean a slackening in the rate of private economic activity.

John Coyne, president of the Building and Construction Trades Department of the American Federation of Labor, traced the history of the efforts of organized labor to adjust jurisdictional disputes between building trades, which culminated in a recent plan worked out in cooperation with the Associated General Contractors of America. This system of adjusting jurisdictional conflicts provides as follows:

1. That there shall be no stoppage of work when a dispute arises.
2. That the trade in possession of the work shall continue it while the dispute is referred to the president of the Department by the local council.
3. That the president of the Department shall notify the national officials of the unions involved and render a decision applying to the case in question, after which the case shall be referred to a national referee for a decision which shall apply generally to similar situations.
4. That the referee is to be advised by two consultants appointed by the president. One of these is to be a contractor of national repute; the other a labor man who has no direct interest in the case.

This plan, Mr. Coyne reported, had been in effect for 45 days at the time of his speech, and had already been highly effective in reducing the number of appeals on jurisdictional matters.

Power Capacity Growing

As of September 30, 1939, the installed capacity of all electric generating plants reporting to the Federal Power Commission aggregated 40,203,969 kw, an increase of 1,161,864 kw, or 3%, since December 31, 1938. Of the total, 85.7% comprise generating stations owned by private utility companies serving the public, 11.6% publicly owned plants, and 2.7% those operated by railroads and other agencies not distributing to the public. Hydroelectric plants accounted for 11,353,925 kw; steam and internal combustion plants for 28,850,044 kw. Of the net increase, hydro totaled 287,862 kw, while steam and internal combustion units increased by 874,002 kw.

Recent major hydroelectric installations reported to the FPC consist of one privately owned 75,000-kw plant in Virginia and a 165,000-kw addition to the generating capacity at Boulder Dam. All other additions in the hydro class were in units of less than 25,000 kw. In steam generation, two private companies reported additions in excess of 50,000 kw, and a municipal plant installed an additional 30,000-kw unit.

U.S. Calls Parleys on Power Grid System

Starting on December 5 the National Power Policy Committee, of which Secretary of the Interior Harold L. Ickes is chairman, began a series of conferences in Washington with the officials of some 50 large public utility companies operating in the eastern part of the United States for the purpose of exploring the possibilities of constructing a series of high-tension power lines tying together the larger generating plants and power-consuming centers in this area, including both private and public developments. A similar plan has been in operation in England for a number of years, being popularly known as the grid system.

While no definite plan has been made public, the proposal envisions connecting links that would make it possible to interchange power whenever necessary between such major load centers as Boston, New York, Philadelphia, Washington, Buffalo, Cleveland,

Detroit, Chicago, St. Louis, and possibly Birmingham, as well as intervening cities. Connections would be made with all major generating stations, both steam and hydro, without regard to whether they are controlled by private capital, municipalities, or the federal government. Construction would cost in the neighborhood of $500,000,000, according to preliminary estimates.

TVA Buys More Lines

In continuation of its policy of buying up privately owned electrical properties within its sphere of operations, the Tennessee Valley Authority has arranged for the purchase from the Mississippi Power Company of transmission and distribution facilities located in northeastern Mississippi for $2,000,000. Consummation of this sale leaves only properties in northern Alabama, now owned by the Alabama Power Company, still to be acquired in order to complete the control of TVA over all electrical facilities within its service area.

The purchases of existing facilities in the TVA areas are being financed in part by the issue of TVA bonds, as authorized by Congress, and in part by the local municipalities and rural electrification cooperatives, which take over and operate distribution facilities in their respective areas.

South Wins Reductions in Freight Rates

Long-continued complaints by shippers in the southern states that the existing railroad freight-rate structure discriminates against their competition with northern producers won partial recognition in a recent ruling by the Interstate Commerce Commission ordering reductions of from 5% to 35% in specific rates applying to a long list of commodities. The decision was reached by a 5 to 4 vote, with two newly appointed commissioners not participating.

In substance, the complaint charged that the railroads charge more for transporting southern products to a market than they do to carry northern products an equivalent distance, with the result that southern producers are subjected to an economic handicap. This was countered with the argument that, because of lower volume, unit costs of transportation in the South are higher than in the North.

The decision was not a clear victory for either side, inasmuch as the ICC, while granting a number of specific reductions, also refused an equally impressive list of other rates enumerated in the complaint, on the ground that discrimination in these instances had not been proved. The net result, in the opinion of transportation experts, is that while the principle of a southern rate differential has been cracked, the practical process of equalizing specific rates will be spread over a long enough period to avert severe economic repercussions upon commercial and industrial conditions and railroad revenues.

Labor Unions Warned

Acting in response to numerous inquiries, Assistant Attorney General Thurman Arnold recently issued a statement of policy clarifying the area within which the Department of Justice is planning to prosecute cases against labor organizations for presumed violation of the anti-trust laws. The action aroused a storm of protest from labor circles, which have hitherto assumed complete immunity from this type of action under the theory that "human labor is not an article of commerce."

In general, Mr. Arnold disclaimed any intention to use the anti-trust laws as an instrument to police strikes or adjudicate labor controversies. The right of labor to organize and to take collective action in efforts to improve its economic status has been amply sustained by the courts and will be respected. But, he pointed out, recent investigations by the Department of Justice into practices in the building industry have revealed a number of instances where labor unions have taken actions that have "no reasonable connection with wages, hours, health, safety, speed-up systems, or the establishment and maintenance of the right of collective bargaining" in order to "perpetuate unnecessarily costly and uneconomic practices in the housing industry." Such practices, he warned, are subject to prosecution as violations of the anti-trust laws.

Specifically, Mr. Arnold listed a number of such practices, as follows:

1. Unreasonable restraints to prevent the use of cheaper materials, improved equipment, or more efficient methods, such as efforts to prevent the installation of factory-glazed windows or factory-painted kitchen cabinets.
2. Unreasonable efforts to compel the hiring of unnecessary labor, an example being the requirement that a member of the local teamsters' union ride on each truck entering a city.
3. Systems of "graft and extortion" by racketeers who interfere with commerce of those who will not pay to be let alone.
4. Attempts to enforce illegally fixed prices, as in the Chicago case where a union is charged with combining with producers and distributors of milk to bar the distribution of milk by persons who refuse to maintain the fixed price.
5. Restraints used in prosecuting a union's war against another union by attacking employers who deal with the second organization.

Pan-American Road Link Covered by Loan

The start of construction on the Nicaraguan section of the Pan-American Highway, which will eventually connect the United States with Panama, is assured by the granting of a $2,000,000 loan to the Central American republic by the Export-Import Bank. Announcement of the loan was made by President Somoza of Nicaragua to coincide with the visit of E. W. James, assistant chief of the U.S. Public Roads Administration, who is in general charge of the project for the United States.

Washington, D.C.
December 6, 1939

News of Local Sections

Scheduled Meetings

CINCINNATI SECTION—Joint meeting with Engineers' Club of Cincinnati at the Engineers' Club on January 18, at 8 p.m.

COLORADO SECTION—Dinner meeting at the University Club on January 8, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers' Club on January 15, at 12:15 p.m.

GEORGIA SECTION—Luncheon meeting at the Atlantan Hotel on January 8, at 12:30 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on January 10, at 6:30 p.m.

LOUISIANA SECTION—Meeting on January 13 in connection with the annual meeting of the Louisiana Engineering Society (to be held at the St. Charles Hotel in New Orleans on January 12 and 13).

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building, New York City, on January 10, at 8 p.m.

MIAMI SECTION—Dinner meeting at the Seven Seas Restaurant on January 4, at 7 p.m.

OREGON SECTION—Dinner meeting at the Congress Hotel on January 5, at 7 p.m.

PHILADELPHIA SECTION—Meeting at the Engineers' Club on January 9, at 7:30 p.m. (Good-fellowship dinner at 6 p.m. at the club.)

ROCHESTER SECTION—Dinner meeting at the Central Y.M.C.A. on January 4, at 6:15 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:10 p.m.

ST. LOUIS SECTION—Luncheon meeting on January 22, at 12:15 p.m.

SEATTLE SECTION—Dinner meeting at the Engineers' Club on January 29, at 6 p.m.

SOUTH CAROLINA SECTION—Annual meeting at Columbia, S.C., on January 5, at 10 a.m.

SYRACUSE SECTION—Dinner meeting at the Onondaga Hotel on January 8, at 6:30 p.m.

TENNESSEE VALLEY SECTION—Dinner meeting of the Chattanooga Sub-Section at the Y.W.C.A. on January 16, at 6:30 p.m.; meeting of the Knoxville Sub-Section at the S & W Cafeteria on January 9, at 5:45 p.m.

Recent Activities

ALABAMA SECTION—*Auburn, November 16, and Birmingham, December 7:* Joint meeting with the Student Chapter at Alabama Polytechnic Institute on November 16. The technical program consisted of a paper on "Bituminous Highways in Alabama." This was given by Leon Gottlieb, bituminous engineer for the Alabama State Highway Department. Short talks by members of the faculty at the Institute concluded the evening. At the December meeting new officers were elected as follows: R. D. Jordan, president; H. D. Burnum, first vice-president; Roy S. Garrett, second vice-president; and J. E. Jagger, secretary-treasurer. Following a discussion on the desirability of increasing the membership of the Society, the speaker of the evening was introduced. This was Dr. Walter B. Jones, who gave a talk on the resources of the state. A brief speech by the president-elect completed the program.

CENTRAL ILLINOIS SECTION—*Springfield, November 16:* Following a dinner, W. B. Walraven, district engineer of the Springfield Sanitary District, introduced the speaker. This was Loran D. Gayton, city engineer of Chicago, who presented an illustrated lecture describing Chicago's new south district filtration plant. A general discussion of the water-supply problems of Chicago followed.

CLEVELAND SECTION—*November 6 and December 5:* The Juniors of the Section were in charge of the program at the November dinner meeting, R. G. Harley acting as chairman. Judge Robert M. Morgan, the guest speaker, discussed the history of riparian rights as they concern the Cleveland lake front and the Cuyahoga River valley. The December meeting took the form of a luncheon and afternoon session, at which George B. Sowers, consulting engineer on the construction of the three new vertical lift bridges being built over the Cuyahoga River, described the unique methods employed in the construction of the cylindrical caissons for these structures. Following a discussion of this talk, the members made a tour of inspection of the various bridge sites, with Mr. Sowers in charge of the group.

COLORADO SECTION—*Denver, November 13:* A talk on "The Contribution of Rail Transportation to Engineering" was the feature of the technical program. This was given by Arthur O. Ridgway, chief engineer of the Denver and Rio Grande Western Railroad. A general discussion followed his talk. Then C. O. Parker Kansas City representative of the A. M. Byers Company, showed five reels of motion pictures. The film was entitled "The New Story of Ancient Wrought Iron."

DAYTON SECTION—*November 20:* Following a luncheon, Jean H. Duquesne, associate airport engineer for the Civil Aeronautics Authority, discussed the program of the Authority. Many interested in Dayton's aviation program took part in the open forum that followed Mr. Duquesne's talk.

DISTRICT OF COLUMBIA SECTION—*November 22:* Since the November meeting of the Section is traditionally reserved for Society affairs, the annual reports of the various Section officers and committee chairmen were heard. The report of the Committee on Salaries elicited considerable discussion. Certificates of life membership in the Society were then presented to Dewitt C. Webb, John B. Gordon, and Carl E. Pelz. Other recipients not present were A. B. McDaniel, W. P. Wooten, and Henry M. Waite. The annual election of officers, also held at this time, resulted as follows: John C. Page, president; Clifford A. Betts, vice-president; Benjamin E. Jones, secretary; and John D. Fitch, treasurer. A film entitled "The Making and Shaping of Steel" was then shown through the courtesy of the U. S. Steel Corporation.

GEORGIA SECTION—*Atlanta, October 9 and November 13:* At the first of these sessions the principal speaker was C. F. Palmer, chairman of the Board of Commissioners of the Atlanta Housing Authority. Mr. Palmer gave a résumé of the housing problem, which has resulted in a vast construction program undertaken with federal aid. The principal speaker at the November meeting was D. L. Chaney, regional structural engineer of the Portland Cement Association, who discussed new usages of concrete in railroad construction and maintenance.

ILLINOIS SECTION—*Chicago, November 17:* The president of the Section, L. D. Gayton, gave an illustrated lecture on the water filtration plant now being constructed for the city of Chicago. Mr. Gayton is city engineer of Chicago.

INDIANA SECTION—*Indianapolis, November 10:* Joint meeting with the Central Indiana sections of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. The speaker was C. A. Mills, professor of experimental medicine at the University of Cincinnati, whose topic was "Relation of Climate and Weather to Mankind."

IOWA SECTION—*Des Moines, November 24, and Ames, November 28:* The annual meeting, on the 24th, consisted of afternoon and evening sessions. The first speakers were A. L. Munsell and Alvin Green, presidents of the Student Chapters at Iowa State College and the University of Iowa. Then T. R. Agg, Director of the Society, discussed some of the problems of the Board of Direction. During the business meeting that followed new officers were elected for the coming year. These are R. B. Kittredge, president; M. B Morris, vice-president; and L. O. Stewart, secretary-treasurer. After an informal dinner James L. Ferebee, Vice-President of the Society, discussed the subject, "The Progress of the Engineer." Mr. Ferebee is chief engineer and general manager of the sewerage commission of the City of Milwaukee, Metropolitan Sewerage Commission. The other meeting was a joint session with the Iowa State College Student Chapter. The speaker on this occasion was John Ames, city manager of Ames, who gave a talk on the city manager form of government.

ITHACA SECTION—*November 15:* W. W. Cushing, of the Hamilton (Ontario) Bridge Company, was the speaker and, with the aid of lantern slides and motion pictures, described the erection of the Lion's Gate Bridge over the first narrows in Vancouver Harbor. Mr. Cushing served as supervising engineer for the Hamilton Bridge Company on this project.

LEHIGH VALLEY SECTION—*Bethlehem, Pa., November 13:* An illustrated lecture on the Wild Creek water supply project for the city of Bethlehem was heard on this occasion. This was given by Ario Wear, chairman of the Wild Creek project. An enthusiastic general discussion followed.

LOS ANGELES SECTION—*November 8:* On this occasion—the annual Ladies' Night—the members and their guests were entertained by the Student Chapter at the University of Southern California. During and after dinner a musical program was presented by students at the university. Then A. T. Polyxoides, lecturer on foreign relations at the university, discussed his experiences in Europe during the past summer. Dancing concluded the evening. Section officers for 1940 are W. W. Hurlbut, president; H. F. Blaney, first vice-president; A. L. Gram, second vice-president; and F. D Bowlus, treasurer. Ray L. Derby will continue as secretary.

LOUISIANA SECTION—*Baton Rouge, October 26, and New Orleans, December 4:* The first of these sessions was the fall meeting of the Section, which was held jointly with meetings of the Student Chapters at Tulane University and Louisiana State University. In the afternoon the members were guests of the Louisiana State Highway Commission and the Bethlehem Steel Company for an inspection of the steel erection of the Mississippi River bridge at Baton Rouge. The group then attended a buffet supper, at which E. L. Durkee presented a paper on "Erection of the Main River Spans of the Mississippi River Bridge at Baton Rouge." Mr. Durkee is engineer in charge of steel erection for the Bethlehem Steel Company Arrangements were in charge of a committee headed by N E Lant. The speaker at the December meeting was Paul L. Ristroph, traffic engineer for New Orleans Public Service, Inc. Mr. Ristroph discussed the subject, "Engineering Highway Traffic."

MARYLAND SECTION—*Baltimore, November 16:* Engineering and construction aspects of the Pennsylvania Turnpike was the subject of discussion. Those presenting main papers were Herschel H. Allen and Joseph K. Knoerle, respectively vice-president and project manager for the J. E. Greiner Company, of Baltimore

METROPOLITAN SECTION—*New York City, November 15 and 21:* At the first of these meetings the members heard a talk on the Pennsylvania Turnpike, given by Herschel H. Allen. Joseph K. Knoerle then showed motion pictures and slides illustrating the project. On the 21st the Section cooperated with the department of civil engineering at Columbia University in a joint meeting for the purpose of discussing "Research in Civil Engineering." Those participating in the symposium were Leon Moisseiff, consulting engineer of New York; Walter E. Spear, chief engineer for the New York City Board of Water Supply; and Carlton S. Proctor,

consulting engineer of New York. Each presented some phase of research. The members were then conducted through the civil engineering research laboratories of the university. The program was arranged in cooperation with the Columbia Engineering Schools Alumni Association in connection with the celebration of the 75th anniversary of the founding of the school of engineering at Columbia.

MID-MISSOURI SECTION—*Columbia, October 23:* A résumé of recent articles in CIVIL ENGINEERING initiated the program. The address of the evening was given by B. M. Casteel, director of the Missouri State Highway Patrol, who discussed the subject of highway safety.

MOHAWK-HUDSON SECTION—*Albany, N. Y., November 17:* At this, the second annual meeting of the Section, new officers were elected for the coming year. These are as follows: Charles A. Harrell, president; Edward H. Sargent, vice-president; G. Reed Shaw, secretary; and Clyde P. Parkinson, treasurer. The guest speaker of the evening was George J. Nold, major, Corps of Engineers, U.S. Army, who gave an illustrated talk on flood control. Major Nold emphasized the work that is being done in this field in New York State at the present time.

NEW MEXICO SECTION—*Santa Fe, October 18:* Following a business discussion, four reels of motion pictures depicting the construction of Boulder Dam were shown. This film was furnished through the courtesy of the U.S. Bureau of Reclamation.

NORTHEASTERN SECTION—*Boston, November 15:* Joint meeting with the Boston Society of Civil Engineers. Following dinner, Col. William J. Wilgus presented a paper on "America's Problem No. 1—Transportation." The paper was discussed by C. Frank Allen, professor emeritus of engineering at Massachusetts Institute of Technology; Charles B. Breed, professor of railway and highway transportation at Massachusetts Institute of Technology; and others.

OKLAHOMA SECTION—*Fort Sill, November 18:* Joint meeting with the American Institute of Electrical Engineers. This session, which was also open to other engineering clubs and societies, attracted the exceptional attendance of 193. The afternoon session consisted of talks by members of the engineering staff at the Fort, and in the evening three motion picture films were shown through the courtesy of the War Department.

OREGON SECTION—*Portland, November 3 and 14:* Members of the Section interested in hydrology were invited to an informal luncheon on the 3d, held in honor of Merrill Bernard, head of the River and Floods Division of the U.S. Weather Bureau, Washington, D.C., and E. A. Wells, head of the local office of the U.S. Weather Bureau. Mr. Bernard discussed developments in meteorology and hydrology and discussed the Bureau's methods of weather forecasting. On the 14th C. I. Grimm, chairman of the program committee, presented an illustrated paper on "Features of Design and Construction of Dams in the Northwest." Mr. Grimm's talk was amplified by other illustrated talks on the same subject. These were given by B. E. Torpen, principal engineer in the Corps of Engineers, U.S. Army, who is on the Bonneville Project; and H. E. Brown, Jr., N. H. Leupold, and B. L. Peterson, all of whom are in the U.S. Engineer Office at Portland.

PANAMA SECTION—*September 10 and 18, October 27, and November 9:* On September 10 the Section and the Panama Society of Civil Engineers enjoyed a joint inspection trip to the sites of the Pacific locks on the projected enlargement of the Panama Canal. At each stop the designing engineer and the geologist lectured on the project, making use of maps and core samples to bring out the reasons for locating each lock, the approach channels, and the various utilities. On the 18th A. A. Mittag gave a talk on "Spanning the Pacific," in which he stressed the technical difficulties that were overcome in building bases on Wake, Midway, and Guam islands. The speaker at the October meeting was C. P. Gross, lieutenant colonel, Corps of Engineers, U.S. Army, whose subject was "The Nicaraguan Barge Canal." Two reels of colored motion pictures depicting flood control projects now under construction in the Pittsburgh (Pa.) district were enjoyed at the November meeting. These were shown by C. M. Wellons, of the Corps of Engineers, U.S. Army, who is in Panama in a consulting capacity on the construction of the locks.

PHILADELPHIA SECTION—*November 14:* Judging from the large turnout, the Bronx-Whitestone Bridge, which was discussed at this meeting, was a popular subject. Particularly gratifying was the large attendance of Juniors and Student Chapter members. Those who spoke on the bridge were Allston Dana, designing engineer for the Port of New York Authority, who gave the history of the project and the function of the bridge in the New York region; and Samuel J. Ott, division engineer for the American Bridge Company, who showed slides and described the erection procedure used in construction. An enthusiastic discussion concluded the technical program, which was in charge of Prof. H. L. Bowman.

PITTSBURGH SECTION—*November 28 and December 7:* The first of these sessions was a joint meeting with the civil section of the Engineers' Society of Western Pennsylvania. An illustrated lecture on developments in transmission lines and the design and testing of full-sized towers was given by N. B. Obard, contracting engineer for the American Bridge Company. A social gathering, at which numerous guests were entertained, comprised the December meeting. On this occasion a sound film, entitled "The Making and Shaping of Steel," was shown through the courtesy of the U.S. Steel Corporation.

ROCHESTER SECTION—*October 19, November 21 and 28, and December 5:* The first of these sessions was a joint meeting of the Section, the Rochester section of the American Society of Mechanical Engineers, and the Rochester Engineering Society. The feature of the occasion was an illustrated lecture on dams, given by Donald M. Simmons, chief engineer of the General Cable Corporation, New York City. The last three sessions were weekly luncheon meetings, in which the Section participated with the Rochester Engineering Society. The speakers heard at these gatherings were Harold W. Baker, city manager of Rochester; William H. Roberts, commissioner of public works of Rochester; and Cornelius E. Elmendorf, civil engineer for W. S. Lozier, Inc.

SACRAMENTO SECTION—*November 14, 21, and 28:* The usual weekly luncheon meetings took place on these dates, the speakers being Albert G. Mott, director of the valuation division of the State Board of Equalization; Harry S. Riddell, assistant engineer for the U.S. Bureau of Reclamation; and Michael J. Brickley, professor of history at Sacramento Junior College. Mr. Mott described a recent flight around the world, which he made in commercial planes in seven days; Mr. Riddell showed colored slides, depicting construction progress on the Central Valley Project; and Professor Brickley outlined world happenings since 1914. *Junior Forum, November 8:* A discussion on the possibility of achieving world peace was the feature of the occasion. The technical program consisted of a talk on "Modern Achievements in Sanitary Engineering," which was given by Morgan E. Stewart.

SEATTLE SECTION—*October 30:* Following dinner Roy Harris gave an account of the Local Sections conference held at the time of the Annual Convention. Then Clark Eldridge, speaker of the evening, was introduced. Mr. Eldridge, who is bridge engineer for the Washington State Highway Department, gave an illustrated lecture on the Tacoma Narrows Bridge, on which he is resident engineer.

SPOKANE SECTION—*October 13 and November 10:* The speaker at the October meeting was Glen L. Parker, Director of the Society, who discussed the work of the Board of Direction and outlined some of the problems now confronting the Society. The November luncheon meeting was given over to business discussion.

TACOMA SECTION—*November 14:* It was announced that the following officers have been chosen for the coming year: Bertram P. Thomas, president; Fred C. Dunham, vice-president; and Wells H. Ashley, secretary. A discussion on the Tacoma water supply and distribution system was then given by W. A. Kunigk and John N. Stenger. Both speakers are connected with the Tacoma Department of Public Utilities.

TOLEDO SECTION—*November 16:* This meeting took the form of an inspection trip through the new plant of the Toledo Scale Company. The tour was arranged through the efforts of S. C. McKee, chairman of the program committee, and H. O. Hem, chief engineer of the Toledo Scale Company. The showing of lantern slides explaining some of the processes that had been observed completed the evening.

TRI-CITY GROUP—*Rock Island, Ill., October 20:* At this meeting the Tri-City Group (comprised of Society members in Moline and Rock Island, Ill., and Davenport, Iowa) petitioned the Board of

Direction for the formation of a Local Section to be known as the Tri-City Section. The technical program consisted of talks by William Schmidt, resident engineer on the construction of the new highway bridge being built between Rock Island and Davenport, who described this project; and Francis B. Klein, junior engineer in the U.S. Engineer Office at Rock Island, who discussed a new method of determining the rate of seepage into drainage and levee districts.

WISCONSIN SECTION—*October 28 and November 16:* The principal speaker at the first of these sessions was Grover C. Dillman, president of the Michigan College of Mining and Technology, who discussed the engineer's place in society. At the November meeting the guest speaker was E. N. Otis, of the Chicago Department of Subways and Traction, who gave an illustrated talk on the design and construction of the Chicago subways. It was announced that the officers for 1940 are as follows: C. A. R. Distelhorst, president; C. A. Willson, first vice-president; B. E. Brevik, second vice-president; and Lloyd D. Knapp, secretary-treasurer. James L. Ferebee, Vice-President of the Society, was present at both meetings and discussed the aims and activities of the Society.

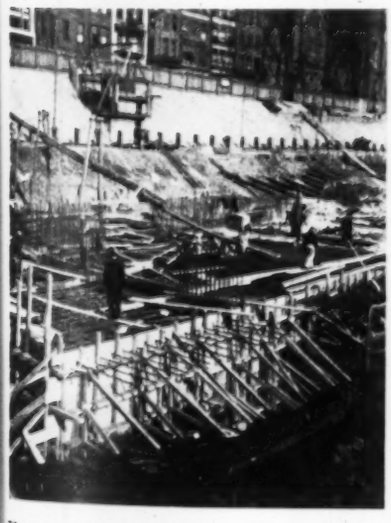
Student Chapter Notes

BROWN UNIVERSITY—*November 6 and 10:* At the first of these sessions the contact member, Harold Miller, was introduced to the new students. Mr. Miller gave a short talk, in which he emphasized the value of making contacts with other members of the profession. Prof. William R. Benford also spoke briefly. On the 10th the Chapter visited a water filtration plant under construction at Pawtucket, R.I.

LEHIGH UNIVERSITY: The Lehigh University Student Chapter has had two meetings this semester. Members of the faculty gave informal talks at the first of these, while Allston Dana, engineer of design for the Port of New York Authority, was the speaker at the second. Mr. Dana discussed the construction of the Bronx-Whitestone Bridge.

NEWARK COLLEGE OF ENGINEERING—*November 13:* This was the second regular meeting of the Chapter this year. Following a brief talk by Jack Rogers, senior representative to the Metropolitan Conference of Student Chapters, the guest speaker was introduced. This was Philip Kissam, associate professor of civil engineering at Princeton University, who discussed the necessity of referencing all land-survey monuments to a permanent system of landmarks, reduced to plane coordinates.

PENNSYLVANIA STATE COLLEGE—*October 30:* On this occasion J. Thompson Henry, county engineer and county surveyor of Centre County, Pennsylvania, gave a talk on the work of these two offices. Twelve members of the Chapter, together with the faculty adviser, contact member, and head of the civil engineering department, attended the November meeting of the Philadelphia Section, constituting the largest Student Chapter delegation to be represented there.



EXCAVATION FOR THE NEW ENGLAND MUTUAL INSURANCE BUILDING INSPECTED BY TUFTS COLLEGE STUDENT CHAPTER

TUFTS COLLEGE—*November 16:* Members of the Chapter, accompanied by Dean Burden, enjoyed a field trip to several points of engineering interest in and about Boston. The first project visited was the relief sewer, which is being tunneled under Chelsea Square in Chelsea under the supervision of the Metropolitan Sanitary Engineers. The next part of the trip was devoted to inspection of the excavation for the New England Mutual Insurance Building, in Boston. Finally the group visited the Framingham plant of the Lock Joint Pipe Company.

SWARTHMORE COLLEGE—*November 9:* At this gathering Carl de Moll spoke on the general subject of "The Consulting Engineer and His Work." Mr. de Moll is architect and engineer for the Ballinger Company in Philadelphia.

TULANE UNIVERSITY—*October 12:* On this occasion members of the Chapter enjoyed an inspection trip aboard a government barge as guests of the First New Orleans District of the U.S. Engineer Office. The students, shown in the accompanying photograph, viewed dredging operations in front of the Julia Street Wharf, New Orleans, and witnessed dynamiting in connection with the removal of a sunken vessel in the Mississippi.

MEMBERS OF TULANE UNIVERSITY STUDENT CHAPTER ABOARD GOVERNMENT BARGE

UNIVERSITY OF ARKANSAS—*November 13:* On this date 13 senior class members of the Chapter and several faculty members inspected the Grand River Dam at Disney, Okla. The visitors were conducted about the project by Victor H. Cochrane, one of the engineers in charge of design, and Mr. Hendricks, chief construction engineer.

GROUP FROM UNIVERSITY OF ARKANSAS STUDENT CHAPTER VISITS GRAND RIVER DAM

UNIVERSITY OF DETROIT—*October 11 and November 16:* At the first of these meetings the speaker was John E. Bebb, chief bridge engineer for the Michigan Central Railroad, whose subject was recent developments in railroad engineering. The speaker at the November meeting was H. A. Humphry, soil-cement engineer for the Portland Cement Association. Mr. Humphry discussed in detail "Soil-Cement Road Construction," supplementing his remarks with motion pictures of actual road construction.

UNIVERSITY OF PENNSYLVANIA—*November 16:* The Society's illustrated lecture on Bonneville Dam was the feature of the occasion. This was presented by Henry R. Dunlap.

VILLANOVA COLLEGE—*November 17:* An inspection trip through the partially completed Queens Midtown Tunnel in New York City was enjoyed on this occasion. The students were able to see the placing of the rings.

ITEMS OF INTEREST

About Engineers and Engineering

CIVIL ENGINEERING for February

IN THE February 1939 issue of PROCEEDINGS, J. A. Van den Broek presented the "theory of limit design." Next month CIVIL ENGINEERING will carry his description of a series of tests of small structural angles, conceived in the light of that theory. The angles tested were those used in the cross-bracing of transmission towers, and the tests indicated that by perforating both legs with extra holes, the ductility of the member as a whole was materially improved without the strength being impaired. The holes were not staggered, since their purpose was to reduce the cross-sectional area, thus distributing the yielding throughout the length of the member and preventing excessive yielding around the connection. Professor Van den Broek's paper was originally presented before the 1939 Annual Meeting of the American Institute of Steel Construction.

Also in the February issue will be a paper by Gilbert C. Dobson and Joe W. Johnson, describing the ingenious equipment and methods employed at the Enoree River Laboratory of the Soil Conservation Service for studying the transportation of sediment in natural streams. The installation that makes possible the quantitative measurement of bed-load movement is of particular interest and importance.

"A Survey of the Frost-Heaving Problem" is the contribution of J. O. Osterberg. In this paper the work done by various investigators is summarized, particular attention being given to the research in Sweden by Dr. Gunnar Beskow. Various applications of research results to frost-heaving problems on roads are discussed, and a selective bibliography is included.

With the first group of papers from the Society's Annual Meeting making up a large part of the February issue, it is not possible to announce other titles definitely as this issue goes to press. They will, however, be selected with a view to covering a wide variety of engineering interests.

ENOREE RIVER CONTROL STRUCTURE AND SEDIMENT ANALYSIS LABORATORY

An Engineer's Recompense

A MAN is known by his works; and this surely must apply to engineers. But sometimes the acknowledgment is tardy and insufficient. Such a case is recalled by James Shand, M. Am. Soc. C.E., with respect to a structure visited in his travels in Argentina. It was the old dam of San Roque in a valley not far from the city of Cordoba.

Of it he writes: "This is a high arched masonry dam and of such a slim section that when the water was allowed to rise in the dam for the first time, the people of the city were terrified it would not stand the strain. The engineer-consultor was clapped in jail until the citizens were somewhat reassured that no disaster was going to happen; and he seems to have been jailed persecuted and threatened every time the dam was flooded and the water came down the spillways. The builder is long since dead, but the dam still stands—a monument to his ability."

Anyone interested in the voyaging and sojourning incident to the life of a construction engineer, especially in the tropics in South America, would enjoy Mr. Shand's manuscript biography, "Way-Faring—a Record of the Life—Travels—and Adventures of a Civil Engineer." The account carries him from his birth and training in Scotland through a long engineering experience in the new world—Mexico, Central America, Canada, and South America on both coasts, covering practically all of the present century. This manuscript, of about 400 typed pages, Mr. Shand has loaned to the Engineering Societies Library where it is available to those interested.

A.S.A. Work on Coordinating Dimensions of Building Materials Progresses

PROGRESS in the American Standards Association's cooperative project in coordinating the dimensions of building materials and equipment is reported by Myron W. Adams, secretary of the committee in charge of the work, in the December issue of *Industrial Standardization*. Four special research committees have been organized to start on the detailed work, he reports One of these is dealing with masonry materials of structural clay products, a second with wood doors and windows, a third with masonry of concrete and cast stone, and a fourth with metal windows. Two more committees are in prospect—one to cover natural stones and one for structural wood—and others will be set up as the whole project develops.

"Our objective," writes Mr. Adams, "is to make building parts available to the industry in standard sizes and dimensions that are coordinated. By 'building parts' we mean the building materials, accessories, and equipment items in the form that they are delivered to the building site for erection. They include the building structure, a variety of collateral materials, and all accessory and equipment items that are permanently fitted to the building.

"The coordination of the sizes and dimensions of these parts is our immediate problem and specific task. What is coordination? It is a relationship between the sizes and dimensions of the parts that will assure their proper interfitting within the building structure. Our plan is that these coordinated sizes will be predetermined and listed as standards suitable for coordination. They will be established in varieties sufficient to meet the general requirements of utility and design.

"This work has possibilities which cannot even be estimated as yet. . . .The first and most apparent economy that coordination offers is a reduction in field erection costs. This includes both labor and materials, with consequent economy in freight and handling."

Again, "Many of the producing industries are now faced with problems of simplifying their present standards. There exists much duplication and overlapping of sizes which unnecessarily increase the costs of the manufacturer and jobber. Some of these industries believe that this project will afford them a logical and authoritative basis for accomplishing a simplification of sizes that is urgently needed.

"Certain producers have called attention to other manufacturing economies and advantages that would result from standardization of their product. One industry points out that standardization will make possible the use of raw material

for which at present no market can be found. Another manufacturer has stated that production on a quantity basis will result in important improvements in the quality of his finished product.

"Just within the last week another advantage of coordination has been brought forcibly to my attention. In planning large housing projects the backers frequently wish to get accurate estimates on alternate building materials and construction systems. This usually requires a complete new layout and detailing of the project for each material, making alternate estimates very costly. With the development of coordinated sizes, however, one nominal layout will apply without change to all building materials in any combination."

Brief Notes from Here and There

SOMEWHAT unusual is the naming of a public school for an engineer. In Emeryville, Calif., the late Ralph S. Hawley, M. Am. Soc. C.E., is to be thus honored next month in a special ceremony changing the name of the Sutter Elementary School to the Ralph S. Hawley School. Action by the school board followed a petition initiated by the Parent-Teachers Association. Mr. Hawley, for 18 years city engineer of Emeryville, had been president of the school board for 12 years.

* * * *

THE 1940 Road Show—Convention of the American Roadbuilders Association is scheduled for January 29 to February 2 in the International Amphitheater in Chicago. Concurrently, on January 30 and 31, the National Paving Brick Association holds its 34th annual meeting in the Congress Hotel in the same city.

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TENTATIVE specifications for solid load bearing concrete masonry have been issued by the American Society for Testing Materials and are now available from that organization, 260 South Broad Street, Philadelphia, for study and criticism.

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FOR the engineer fisherman, a most useful formula was recently brought to the attention of CIVIL ENGINEERING by a friend of the late J. A. L. Waddell, Hon. M. Am. Soc. C.E. It appears to have been developed by Dr. Waddell after years of intensive, first-hand research in the waters off Florida, Texas, and the Bahamas:

$$W = \frac{lg^2}{800}$$

in which W is the weight of the fish in pounds; l, its length in inches, from tip of snout to middle of line joining forked ends of tail; and g, the maximum girth in inches. The blueprint table accompanying the formula goes as high as 251 lb, which should have served for everyday use—but Dr. Waddell, who went in quest of shark, giant ray, and tarpon, and at times held records for the largest catch of some of these species, probably had an occasional computation to make even with his table at hand.

* * * *

UNDERGRADUATE engineering curricula accredited by the Engineers' Council for Professional Development now total 525, with 118 colleges and universities represented. The 1939 list has just been issued and can be obtained from E.C.P.D., 29 West 39th Street, New York, N.Y., at 25 cents a copy.

* * * *

SPEAKING before the Metropolitan Section on October 18, Charles E. Smith, M. Am. Soc. C.E., vice-president of the New York, New Haven and Hartford Railroad, mentioned an interesting analysis he had made of the engineering background of the officers of American railroads. He confined himself to Class I roads. According to Mr. Smith, 36 per cent of the mileage of such roads is under the presidency or chairmanship of graduate civil engineers; 40 per cent is under other college graduates; and the remaining 24 per cent is under those who have graduated from the school of hard knocks. He listed the following lines in the first category: Chesapeake and Ohio; Chicago, Burlington and Quincy; Chicago, Rock Island and Pacific; Illinois Central; Missouri Pacific; Northern Pacific; Pere Marquette; Pennsylvania; Virginian; Texas Pacific; and Wabash.

NEWS OF ENGINEERS

Personal Items About Society Members

WILFRID C. POLKINGHORNE, associate professor of civil engineering at Michigan College of Mining and Technology, has been appointed to fill the vacancy on the Michigan State Board of Examiners for the Registration of Architects, Professional Engineers and Land Surveyors

JOHN AMES, city manager of Ames, Iowa, has been elected vice-president of the International City Managers Association

G. J. WATSON has been made plant engineer for the American Bridge Company at Elmira, N.Y., succeeding HENRY W. PRESTON, who has retired. Mr. Watson was formerly squad engineer for the company.

WILLIAM S. WALKER has resigned as professor of civil engineering at the Chicago Technical College to accept the position of senior highway engineer with the Pennsylvania State Department of Highways. His headquarters are in Pittsburgh.

ROBERT HAWXHURST, JR., mining engineer and geologist, has been elected president of the Engineers' Club of San Francisco.

A. H. PANDYA is now principal of the Bengal Engineering College at Howrah, India. He was formerly chief engineer for Diagrid Structures, Ltd., London, England.

ROBERT T. REGESTER announces the opening of an office for the practice of sanitary engineering in the Baltimore Life Building, Baltimore, Md. Until lately he was associate engineer for Whitman, Requardt and Smith, of Baltimore.

CARL H WALTHER, previously in the employ of the Bethlehem Steel Company at Bethlehem, Pa., is now instructor in civil engineering at George Washington University, Washington, D.C

FREDERICK N. GRANT has been promoted from the position of district engineer for the Arizona State Highway Department to that of deputy state engineer. J. R. VAN HORN succeeds him as district engineer.

WILLIAM G. GROVE, associate engineer in the Connecticut State Highway Department, has been appointed part-time instructor at Hillyer Junior College, Hartford, Conn.

JOHN C. SPRAGUE has resigned as chief of the concrete and soils section of the U.S. Engineer Office at Huntington, W.Va., to join the staff of the Dravo Corporation as development engineer in the Keystone division. His headquarters are in Pittsburgh.

ROGER B. MCWHORTER has been appointed by President Roosevelt to membership on the International Joint Commission which supervises the United States-Canada boundary. Mr. McWhorter is chief engineer of the Federal Power Commission, in Washington D.C.

CHARLES L. HILL, former city engineer of Reno, Nev., has been made secretary-manager of the Nevada chapter of the Associated General Contractors of America.

JOE DE AROZENA has been appointed to the newly created position of engineer of contract construction for the Arizona State Highway Department. He was formerly resident engineer for the department at Wickenburg, Ariz.

ARTHUR B. MORRILL, assistant civil engineer of sanitary design with the Detroit (Mich.) Department of Public Works, has been appointed plant manager of the city's new $22,000,000 sewage disposal plant at Jefferson Avenue and the Rouge River.

ANDREW G. BISSET, commander, Civil Engineer Corps, U.S. Navy, has been transferred from the U.S. Naval Academy at Annapolis, Md., to duty as public works officer at the Navy Yard, Portsmouth, N.H. He will succeed COMMANDER CARL H. COTTER, who has been transferred to Jacksonville, Fla., to serve as officer in charge of construction of the naval air base there.

CHARLES R. JOHNSON, commander, Civil Engineer Corps., U.S. Navy, has been transferred from the Navy Yard

at Philadelphia, Pa., to duty as public works officer at the U.S. Naval Academy, Annapolis.

GANO DUNN and LEON S. MOISSEIFF were two of twelve outstanding graduates of the Columbia University School of Engineering recently selected to receive the first awards of medals for distinguished engineering achievement established in memory of Prof. Thomas Egleston, pioneer in engineering education. The awards were presented at a special university convocation, held in Low Memorial Library on November 27.

CHARLES T. MAIN is one of four engineers who have just been made honorary members of the American Society of Mechanical Engineers. The presentation of certificates took place at the sixtieth annual meeting of this organization, which took place in Philadelphia, December 4 to 8.

GEORGE F. NICHOLSON, consulting engineer of Los Angeles, Calif., has been appointed consultant for the Port of Long Beach, Calif. He will prepare a comprehensive plan for the future development of this port and advise on the design and construction of port facilities.

LON C. INGRAM, JR., has been transferred to the Austin office of the Texas State Highway Department. He was formerly resident engineer at Lubbock.

JAMES H. MURDOUGH, professor and head of the department of civil engineering at Texas Technological College, has been appointed a member of the planning board for the city of Lubbock, Tex.

WAYNE D. BRANICK, formerly resident engineer for the WPA at Girard, Kans., is now employed as a draftsman in the U.S. Engineer Office at Vicksburg, Miss.

RINARD T. LIERBOE, JR., who is in the Bureau of Biological Survey of the U.S. Department of the Interior, has been transferred from New Orleans, La., to Denver, Colo., where he is engineering inspector for Region No. 2. The territory in this region consists of Colorado, Utah, Wyoming, Idaho, and Montana.

WILLIAM O. HOUSTON, previously division engineer for the Michigan Central Railroad, has been appointed district engineer in charge of engineering and maintenance in the territory embracing the Canada, Michigan, and Western divisions. His headquarters are in Detroit.

GEORGE A. SOPER, consulting engineer of New York City, has been appointed a consultant to the U.S. Housing Authority and assigned to the management division of the Authority.

GEORGE S. RICHARDSON has opened a consulting office in the Westinghouse Building, Pittsburgh, Pa. He will specialize in bridges, buildings, and other types of structural work.

ROBERT L. MACDOUGALL, for the past year technical director of the Atlanta (Ga.) Housing Authority, has been made state WPA administrator for Georgia.

C. C. HOCKLEY, who has been serving as regional director of the PWA at Portland, Ore., has reopened his consulting engineering offices in Portland.

C. W. GAMBLE, civil engineer of Victoria, B.C., is now senior assistant engineer at the Royal Canadian Air Force Station at Patricia Bay.

WILLIAM BOWIE has been elected executive secretary of the Society of American Military Engineers and editor of *The Military Engineer*, the journal of the Society. Until his retirement in 1937 Major Bowie was chief of the division of geodesy of the U.S. Coast and Geodetic Survey.

WILLIAM S. BARRETT is serving as an instructor in civil engineering at the University of Texas during his leave of absence from the Texas State Highway Department.

WILLARD E. SIMPSON, JR., has severed his connection with the Texas State Highway Department in order to enter the Massachusetts Institute of Technology, where he is doing graduate work.

EDWARD F. BERRY has been promoted to the position of professor and head of the department of civil engineering at Syracuse University. He was formerly associate professor of civil engineering.

DECEASED

RAYMOND FRANCIS ALMIRALL (M. '04) New York City architect, died on May 18, 1939, at the age of 70. Mr. Almirall was a student at the Ecole des Beaux Arts in Paris for three years and then—in 1895—began a general architectural and engineering practice in New York. From 1900 on he had his own firm, which was responsible for the construction of many buildings in New York, Jersey City, and Brooklyn. Mr. Almirall served on the New York State Tenement House Commission and other similar bodies.

GEORGE ERLE BEGGS (M. '23) professor of civil engineering at Princeton University, died at his home in Princeton, N.J., on November 23, 1939, at the age of 56. Professor Beggs' early experience included teaching at Union College and work for the American Bridge Company and the Phosphate Mining Company of Florida. He went to Princeton in 1914 to teach structural engineering and became head of the civil engineering department in 1937. Shortly before his death he was chosen chairman of the Engineering Foundation. Professor Beggs was the originator of a method of determining stresses in structures from tests of small models.

RALPH HOWE CADY (M. '36) engineer and foreign representative of the Frederick Snare Corporation, New York, N.Y., died at his home in Tenafly, N.J., on November 29, 1939. He was 45. Since 1920 Mr. Cady had been associated with the Frederick Snare Corporation as a designing and construction engineer for port works, steamship terminals, bridges, and other engineering structures in various parts of the United States and South America. During the war he was attached to the Sanitary Corps of the U.S. Army.

THOMAS JENKS CARLILE (M. '07) of Hempstead, N.Y., died on November 28, 1939, at the age of 67. From 1905 until his retirement in 1931 Mr. Carlile was in the employ of the Long Island Railroad, serving successively as assistant engineer, principal assistant engineer, and construction engineer. Earlier in his career he was engaged in railroad work in the East and, for eight years, was in the Philadelphia (Pa.) Bureau of Surveys.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

LOUIE THEODORE JESSUP (Assoc. M. '20) drainage engineer for the U.S. Bureau of Agricultural Engineering at Yakima, Wash., died there recently at the age of 50. In 1913, at the outset of his career, Mr. Jessup became drainage engineer for the U.S. Bureau of Public Roads (now the Public Roads Administration) at Yakima. A short time ago he was transferred to the engineering department of the Soil Conservation Service.

PAUL N. NUNN (M. '04) president of the Telluride Power Company, Salt Lake City, Utah, died at his home in San Diego, Calif., on October 27, 1939, at the age of 79. In 1890 Mr. Nunn moved to Telluride, Colo., where with his brother, he designed and installed the first commercial power-transmission system employing high-voltage alternating current, which made long-distance transmission practicable. From this beginning grew the Telluride Power Company, which eventually extended its system through a number of Western states. From 1906 to 1910 Mr. Nunn was chief engineer of the Ontario Power Company, and from 1912 to 1917 president and manager of the Wyoming Electric Company. From 1917 on he was president and director of the Telluride Power Company.

ALOIS PHILLIP POIROT (Assoc. M. '15) civil engineer of Belleville, Ill., died on November 9, 1939, at the age of 55. In 1908—after early experience with the Wabash Railroad and the Missouri Pacific—Mr. Poirot became a member of the firm, Slater and Poirot. He remained in this capacity until 1912, when he established his own practice in Belleville.

JACOB BRUNN REINHARDT (Assoc. M. '11) senior construction engineer for the Board of Education at Rochester, N.Y., died on November 11, 1939. He was 58. For a number of years Mr. Reinhardt was in the employ of the New York Central Railroad—engaged in track relocation

and grade-crossing elimination in upstate New York and, later, as assistant engineer in the valuation department. About fifteen years ago he became senior construction engineer for the Rochester Board of Education.

ALFRED HOWARD RENSHAW (M. '98) chairman of the Board of the General Railway Signal Company, New York, N.Y., died on June 16, 1939. Mr. Renshaw, who was 77, was the inventor of car couplers and railroad signal appliances. For many years he was connected with the General Railway Signal Company and, before that, was successively with the Trojan Car Coupler Company, the Standard Railway Signal Company, and the Federal Signal Company. He was a major in the 3d Brigade of the New York National Guards.

GEORGE FUERLE SCHLESINGER (M. '22) chief engineer and managing director of the National Paving Brick Association, died at his home in Washington, D.C., on December 1, 1939. Mr. Schlesinger, who was 54, was a member of the faculty at Ohio State University from 1913 to 1917. During the war he served as engineer on government war construction projects, and in 1919 he joined the staff of the Ohio State Highway Department. He severed this connection in 1928 to accept the post with the National Paving Brick Association, which he held until his death. Mr. Schlesinger also edited the association's magazine, *Dependable Highways*, and was the author of numerous technical articles.

HERBERT WESLEY SMALL, JR., (M. '29) who was with the W. S. Lee Engineering Corporation at Charlotte, N.C., died recently at the age of 47. From 1917 to 1918 Mr. Small was in the U.S. Engineer Office at Wilmington, Del.; from 1919 to 1922 with Stone and Webster, Inc., at Boston, Mass.; and from 1922 to 1927 principal assistant for the Fargo Engineering Company at Jackson, Mich. Later he was chief engineer for the Alcoa Power Company at Arvida, Canada.

WILLIAM W. K. SPARROW (M. '18) vice-president of the Chicago, Milwaukee, St. Paul and Pacific Railroad, Chicago, Ill., died on November 7, 1939, at Evanston, Ill. Mr. Sparrow, who was 59, had been with the Chicago, Milwaukee, St. Paul and Pacific for a number of years. Earlier in his career he was valuation engineer for the Chicago, Burlington and Quincy Railroad.

FREDERICK NEWTON WILLSON (M. '26) professor emeritus of graphics and engineering drawing at Princeton University, died at Princeton, N.J., on November 16, 1939. He was 83. Professor Willson retired in 1923 after serving on the Princeton faculty for forty-three years—he founded the university's department of graphics in 1883, and a professorship was created for him three years later. He was the author of numerous textbooks on descriptive geometry and graphics.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From November 10 to December 9, 1939, Inclusive

ADDITIONS TO MEMBERSHIP

ACREE, GEORGE (Assoc. M. '39), Engr., Ash-Howard-Needles & Tammen, 1012 Baltimore Ave., Kansas City, Mo.

AINSWORTH, CULVER MARTIN (M. '39), 915 McKelligon Ave., El Paso, Tex.

ALLAIRE, JAMES MORTIMER (Jun. '39), 2265 Eighty-fourth St., Brooklyn, N.Y.

ALLEN, JOHN WINFIELD (Jun. '39), 105 Talbot Laboratory, Univ. of Illinois, Urbana, Ill.

ANDERSON, WENDELL DRUMMOND (Assoc. M. '39), Field Engr., Southern Vitrified Pipe Assoc., 628 Sycamore St., Cincinnati, Ohio. (Res., 217 South 11th St., Griffin, Ga.)

ANSLEY, JOHN MCKELLAR (Jun. '39), Cost Engr., Columbia Constr. Co., Inc., Redding, Calif.

ARNOLD, ROBERT JAY (Jun. '39), Junior Civ. Engr., U.S. Engrs., Room 402 Chamber of Commerce Bldg. (Res., 3264 Latonia Ave., Dormont), Pittsburgh, Pa.

BARDOFF, JULIAN LAWRENCE (Jun. '39), 3022 Encinal Ave., Alameda, Calif.

BARNHILL, KENNETH GRAHAM (Jun. '39), 25 East 99th St., New York, N.Y.

BAUER, JOHN HAROLD (Assoc. M. '39), Asst. Engr., U.S. Dept. of Agriculture, Forest Service, 191 Main St. (Res., Colrain Rd.), Greenfield, Mass.

BAUM, ROBERT OLIVER (Jun. '39), Engr., Office, State Bureau of Highways (Res., 648 South 6th Ave.), Pocatello, Idaho.

BEADLES, CHARLES EDWARD (Jun. '39), Loop Rd., Monroe, La.

BECKMAN, EMIL WILLIAM (Jun. '39), Draftsman, A. T. & S. F. Ry., 80 East Jackson Boulevard (Res., 5549 North Winthrop), Chicago, Ill.

BEJCEK, OTTO JOHN (Jun. '39), Draftsman, Maricopa County Municipal Water Conservation Dist. 1, 927 Title and Trust Bldg., Phoenix, Ariz.

BERRAW, BERGEN FREDERIC (Jun. '39), Junior Eng. Aid, Public Roads Administration, Waynesboro, Va.

BIGGERS, JAMES BRADFORD (Assoc. M. '39), Dist. Engr., The Truscon Steel Co., 1009 Baltimore, Kansas City, Mo.

BINGER, WILSON VALENTINE (Jun. '39), Junior Engr., U.S. Engr. Office, A and Poplar Sts., Wilmington, Del.

BLEDSOE, BYRON AUGUSTUS (Jun. '39), Asst. Eng. Aide, U.S. Engr. Office, Box 60, Vicksburg, Miss.

BODDORFF, RAYMOND DEAN (Jun. '39), Serviceman, Hercules Powder Co., 8 West Broad St., Hazleton, Pa.

BOEHNKE, ROBERT CARL (Jun. '39), Civ. Engr. (Hydr. Research), Am. Rolling Mill Co. (Res., 1400 Woodlawn Ave.), Middletown, Ohio.

BOLZER, MORRIS SAMUEL (Jun. '39), Computer and Draftsman, Blackie & Wood, 1320 Alaska Commercial Bldg., San Francisco, Calif.

BONELL, WILLIAM HENRY (Jun. '39), Structures Research Engr., Lockheed Aircraft Corporation (Res., 512 Harvard Rd.), Burbank, Calif.

BOWERS, CHESTER HUFFMAN (Jun. '39), Surveyor, Seismograph Service Corporation, 709 Kennedy Bldg., Tulsa, Okla. (Res., 2315 Cass St., Fort Wayne, Ind.)

BRAME, WILLIS VINTON (Jun. '39), 208 South Main, Ada, Ohio.

BRENNAN, MARTIN HOGAN (M. '39), Mgr., Buffalo Div., Great Lakes Dredge & Dock Co., 1100 Morgan Bldg., Buffalo, N.Y.

BRIECE, LEO THOMAS (Assoc. M. '39), Right of Way Engr., State Highway Comm., 329 South Kirkwood Rd., Kirkwood, Mo.

TOTAL MEMBERSHIP AS OF DECEMBER 9, 1939	
Members	5,591
Associate Members	6,316
Corporate Members	11,907
Honorary Members	32
Juniors	3,985
Affiliates	73
Fellows	1
Total	15,998

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BULLOCK, JOHN EARL (Jun. '39), Junior Engr., Natural Gas Pipelines Co. of America, 20 North Wacker Drive, Chicago, Ill. (Res., Glasco, Kans.)

BURCKHARDT, ERNEST GUSTAV (Jun. '39), 4001 First Ave., Sacramento, Calif.

BYRD, KENNETH DAVIS (Jun. '39), Engr., Const. Dept., Ore Mines and Quarries, Tennessee Coal, Iron & R. R. Co., Muscoda, Bessemer, Ala.

CAHILL, ROBERT WILLIAM (Jun. '39), Civ. Engr. Cahill Bros., Inc., 206 Sansome St., San Francisco, Calif.

CAMPBELL, JOHN ALLISON (Jun. '39), Engr., John F. Casey Co., Box 1888, Pittsburgh (Res., 111 Emerson Ave., Aspinwall), Pa.

CANON, JEAN HARTFORD (Jun. '39), Testing Engr., Jersey Testing Laboratories, 154 Wright St., Newark (Res., 318 East Main St., Somerville), N.J.

CAPS, JAMES WILLIAM (Jun. '39), Junior Engr., Grade A, State Highway Comm., 946 Ohio St., Lawrence, Kans.

CARHART, RUFUS CHAMBERLAIN (Assoc. M. '39), Res. Engr., State Highway Dept., North Main St. (Res., 513 Culberson St.), Paris, Tex.

CHAMBERLAIN, GLENN JOHN (Jun. '39), Junior Bridge Engr., State Bridge Dept., Box 1499 (Res., 4842 Que St.), Sacramento, Calif.

CHAPMAN, IRA THOMAS (Jun. '39), R. R. 4, Sumner, Ill.

CHARLES, JOHN ROY (Jun. '39), With Layne New York Co., Inc., 6418 Jackson St., Pittsburgh, Pa.

CHITTENDEN, HIRAM MARTIN (Assoc. M. '39), Asst. Prof., Civ. Eng., Univ. of Washington, Seattle, Wash.

CHRISTIANO, NATALE ANTHONY (Jun. '39), Draftsman, State Dept. of Highways, Wabash Bldg. (Res., 353 Ophelia St.), Pittsburgh, Pa.

CIANCIA, CHARLES PHILIP (Jun. '39), With Reliable Constr. & Eng. Co. (Res., 467 Greenmount Ave.), Grantwood, N.J.

CORTRIGHT, DONALD NATHAN (Jun. '39), Junior Eng. Aid, TVA, 25 Rockwood Ave., Rockwood, Tenn.

CULLER, RICHARD CARLTON (Jun. '39), Junior Engr., U.S. Geological Survey, 906 Chamber of Commerce Bldg., Pittsburgh, Pa.

CUMMINS, NEIL JOSEPH (Jun. '39), Senior Eng. Aid, U.S. Engrs. (Res., 3006 Ninth Ave.), Los Angeles, Calif.

DAY, ELROY KENNETH (Jun. '39), 10 Mellen St., Cambridge, Mass.

DEITS, GORDON ROBERT (Jun. '39), Junior Engr., U.S. Army Engrs., 628 Pittock Blk. (Res., 1956 North West Everett Ave.), Portland, Ore.

DESMOND, RICHARD ROBERT (Jun. '39), 1839 Trapelo Rd., Waltham, Mass.

DIXON, DURWOOD BURTRUM (Jun. '39), 916 South Broadway, Albuquerque, N.Mex.

DONALDSON, WILLIAM ELMER (Assoc. M. '39), Structural Engr., Am. Steel & Wire Co., Rockefeller Bldg., Cleveland (Res., 17327 Madison Ave., Lakewood), Ohio.

DUKE, CHARLES MARTIN (Jun. '39), 1514 Walnut St., Berkeley, Calif.

DUNKIRK, GEORGE LEONARD (Jun. '39), Eng. Draftsman, Bridge Div., State Highway Dept., State Office Bldg. (Res., 607 West Genessee St.), Lansing, Mich.

ELLIOT, REED ARCHER (Assoc. M. '39), Associate Hydr. Engr., TVA, 515 Union Bldg., Knoxville, Tenn.

EMMICK, EDWARD FRANKLIN (M. '39), Res. Engr., State Dept. of Highways, Box 176, Hoquiam, Wash.

FARNETI, NELLO (Jun. '39), Project Engr., Constr. Quartermaster, Chanute Field, Rantoul (Res., 1007 South Locust, Champaign), Ill.

FARR, FREDERICK, JR. (Jun. '39), 659 Ross Ave., Hamilton, Ohio.

FATOUT, ROBERT HUGH (Jun. '39), 4528 College Ave., Indianapolis, Ind.

FLAIGG, NORMAN GAIL (Jun. '39), Insp., U.S. Bureau of Mines, Tinton, S.Dak.

FLINT, LAWRENCE LOWELL (Assoc. M. '39), Managing Director, Iowa Eng. Society, Professional Div., 517 Old Colony Bldg., Des Moines, Iowa.

FRASER, EDWARD SMITH, JR. (Jun. '39), 11080 Esmond St., Chicago, Ill.

FRIEDRICH, THOMAS JEFFERSON (Jun. '39), With City Engrs. Office, Waukesha (Res., 6928 West Wisconsin Ave. Wauwatosa), Wis.

FUDGE, FRANCIS JOHN (Jun. '39), Instrumentman, State of Ohio, 701 North King St., Xenia, Ohio.

FULLER, CHARLES GRAY (Jun. '39), Chainman, A. T. & S. F. Ry., Care, T. A. Blair, Chf. Engr., Amarillo, Tex. (Res., 4025 North New Jersey St., Indianapolis, Ind.)

GARD, CHARLES METHENY (Jun. '39), Graduate Asst., Case School of Applied Science, University Circle (Res., 2281 Murray Hill Rd.), Cleveand, Ohio.

GETTY, GEORGE CLINTON (Jun. '39), Junior Engr., Board of Water Supply, City of New York, 33 North Moger Ave., Mount Kisco, N.Y.

GIBSON, DAVID IRVIN (Jun. '39), Care, Mr. H. A. Watson, The M. W. Kellogg Co., Box 677, Haifa, Palestine

GILLETTE, FRANK ALBERT (Assoc. M. '39), Bldg. Insp., City of Montgomery, City Hall, Montgomery, Ala.

GIVAN, CHARLES VERNON (Assoc. M. '39), Asst. Prof. of Irrigation, Univ. of California, University Farm, Davis, Calif.

GOSHORN, JOHN DAVID (Jun. '39), 934 Maplewood Ave., Ambridge, Pa.

GRAHAM, JOHN WILLIAM, JR. (Jun. '39), 29 William St., Princeton, N.J.

GREETIN, PAUL BERNARD JR. (Jun. '39), 211 Stokes Ave., Neptune, N.J.

GUNWALDSEN, RALPH WERNER (Jun. '39), Junior Engr. (Civ.), U.S. Army Engrs., Chamber of Commerce Bldg. (Res., 1627 Princess Ave.), Pittsburgh, Pa.

HAINSWORTH, BRUCE ALEXANDER (M. '39), Project Engr., H. K. Ferguson Co., Hanna Bldg., Cleveland, Ohio. (Res., 1406 Pearson St., Houston, Tex.)

HALL, EMERSON EUGENE (Jun. '39), Sub-Insp., U.S. Army Engrs., Box 25, Lundell, Ark. (Res., 15 White Pl., Bloomington, Ill.)

HALSEY, EUGENE LUDLOW, JR. (Jun. '39), Detailer, Am. Bridge Co., 608 Third St., Ambridge, Pa.

HARTER, DONALD STEPHEN (Jun. '39), Junior Engr., Timber Eng. Co., 1337 Connecticut Ave. (Res., 1738 M St., N.W.), Washington, D.C.

HEAD, JAMES ALBERT (Jun. '39), Senior Office Asst., State Highway Dept., Box 30 (Res., 260 Vista Ave.), Salem, Ore.

HELLMANN, FRANCIS RICHARD, JR. (Jun. '39), With Ashland Oil & Refining Co., 13th and Winchester (Res., 2210 Montgomery Ave.), Ashland, Ky.

HERCULES, CHRISTOPHER DEJEAN (Jun. '39), Archt. Engr., Sargent & Lundy, Inc., 140 South Dearborn, Chicago (Res., 1810 Sherman, Apartment 3, Evanston), Ill.

HIATT, WRIGHT (Jun. '39), Lieut., Corps of Engrs., U.S.A., U.S. Waterways Experiment Station, Vicksburg, Miss.

HISLER, ANDREW LEO (Assoc. M. '39), Asst. Supt., Conduit Div., Potomac Elec. Power Co., 10th and Florida Ave., N.W. (Res., 5132 Seventh St., N.W.), Washington, D.C.

HODSON, ROBERT WILLIAMS (M. '39), Div. Engr., State Highway Dept., 329 South Kirkwood Rd., Kirkwood, Mo.

HOEFLER, OTTO (Jun. '39), Junior Engr., U.S. Engrs., Bldg., 616 East Contonment, Presidio (Res., 432 Collingwood St.), San Francisco, Calif.

HOGLE, JAMES CARLTON (Jun. '39), Draftsman, N. Y. C. System, Room 518 M. C. Terminal, Detroit (Res., 809 East Kingsley St., Ann Arbor), Mich.

HOLZER, MARVIN LAWRENCE (Jun. '39), Junior Engr., Malcolm Pirnie, 25 West 43d St., New York, N.Y.

HUEBNER, GILBERT RUBEN (Jun. '39), Junior Insp., State Highway Dept. (Res., 1009 Ferris Ave.), Waxahachie, Tex.

JACOBSON, ROLAND ARNOLD (Jun. '39), Junior Draftsman, C. B. & Q. R. R., 547 West Jackson Boulevard (Res., 3406 Foster Ave.) Chicago, Ill.

JANVRIN, PHILIP EUGENE (Jun. '39), Engr., Standard Oil Co. of Venezuela, Caripito, Venezuela.

JAQUESS, RONALD CLIFTON (Jun. '39), Contr., 854 South Weinbach Ave., Evansville, Ind.

JENNEY, RICHARD (Assoc. M. '39), Structural Engr., United Engrs. & Constrs., Inc., 1401 Arch St., Philadelphia (Res., 625 Haydock Lane Haverford), Pa.

JOHNSON, CHARLES HOWARD (Jun. '39), 1102 West Clark St., Urbana, Ill.

KALTENBACH, ALBERT BOSSYNS (Jun. '39), Box 96, Las Cruces, N.Mex.

KAMINER, JAMES HEATH (Jun. '39), Lexington, S.C.

KASSER, RICHARD CONNOR (Jun. '39), Junior Engr., Victor H. Kasser, 202 East Chicago St., Elgin, Ill.

KAUFMAN, VIVIAN GREGOR (Assoc. M. '39), Asst. Engr., U.S. Waterways Experiment Station, Vicksburg, Miss.

KELFER, OSCAR (Jun. '39), 357 East Commerce St., San Antonio, Tex.

KHEEL, JULIAN (Jun. '39), (Julian Kheel Constr. Co.), 278 Fifth Ave., New York, N.Y.

KIMBALL, RUSSELL FULLERTON (Jun. '39), Care, Public Roads Administration, New Customhouse, Denver, Colo.

KING, OSCAR LLOYD (Assoc. M. '39), City Engr., Municipal Bldg. (Res., 1001 Wateree St.), Kingsport, Tenn.

KIRKBRIDE, DAVID SPENCER (Jun. '39), Draftsman, Eng. Dept., Canadian Industries, Ltd., Montreal (Res., 3-8 Fenwick Ave., Montreal, West), Canada.

KLIMAS, CHARLES OLGERD (Jun. '39), 104-61 One hundred and Nineteenth St., Richmond Hill, N.Y.

KOUBA, ALBERT PETER (Assoc. M. '39), Draftsman, Office of Chf. Engr., P. R. R., 15th and Market Sts., Philadelphia (Res., Chestnut Rd., Paoli), Pa.

LATIMORE, JOSEPH HOYLE (Jun. '39), 70 West Alden St., Coldwater, Mich.

LAWRENCE, ELWOOD ARTHUR (Jun. '39), Junior Engr., U.S. Engrs., Pittock Bldg. (Res., 2281 North West Everett), Portland, Ore.

LAYTON, RAYMOND EDWARD, JR. (Jun. '39), Junior Engr. (Civ.), U.S. Army Engrs., Portland Dist., 1956 North West Everett, Portland, Ore.

LEE, CHARLES ALLEN (Jun. '39), 6 East 4th, Bethlehem, Pa.

LEPPER, HENRY ALBERT (Jun. '39), Instr., Eng Mechanics, Yale Univ., 51 Prospect St., New Haven, Conn.

LINDSEY, JAMES ANDERSON (Jun. '39), Apprentice Draftsman, State Dept. of Highways, 1246 University Ave., St. Paul (Res., 3232 Girard Ave., South, Minneapolis), Minn.

LINGO, DONALD EDWARD (Jun. '39), Senior Foreman Engr., U.S. Dept. of Interior, Camp Miami, Vandalia (Res., 751 Kolb St., Akron), Ohio.

LONG, CHARLES ANDERSON (Jun. '39), Junior Engr., War Dept., Vicksburg Dist., Sardis Dam Site, Sardis, Miss.

LOWELL, ERWIN DWIGHT (Jun. '39), Asst. Field Engr., The Permanente Corporation, Box 28, San Jose (Res., 427 Embarcadero Ave., Palo Alto), Calif.

LYNN, CHARLES FERGUSON (Assoc. M. '39), County Engr., Richland County, County Court House, Columbia, S.C.

MCCUTCHEN, ROY MARSH (M. '39), Maj., Corps of Engrs., U.S.A., Fort Belvoir, Va.

MCGRAYNE, KENNETH DAWSON (Assoc. M. '39), Box 245, Wyckoff, N.J.

MCKEE, KENNETH HENRY (Jun. '39), Susveyman, U.S. Engr. Dept., Room 403 C. of C. Bldg., Pittsburgh, Pa.

MAGOFFIN, JAMES SHELBY (Jun. '39), Michigan Coll. of Mining and Technology, 102 College Ave., Houghton, Mich.

MALLIS, ANGELO GEORGE (Jun. '39), 461 Dickenson St., Springfield, Mass.

MANLEY, EUGENE HAILEY (Jun. '39), Area Supervisor, NYA, Camden, Ark.

MARCUCELLI, THOMAS JOSEPH (Jun. '39), Instrumentman, Stone & Webster Eng. Corporation, Box 1802, Washington, D.C. (Res., 140 Rhode Island Ave., Pawtucket, R. I.)

MAXWELL, FRANCIS WILLIAM (Jun. '39), With Raymond Concrete Pile Co., 140 Cedar St., New York, N.Y.

MAYFIELD, GEORGE MALCOLM (Jun. '39), Laboratory Asst., State Highway Dept., Binder Research, Materials and Tests Div. (Res., 907 East 39th St.), Austin, Tex.

MEANS, ROBERT ROY (Jun. '39), Chainman, A. T. & S. F. Ry. Co., A. T. & S. F. Depot (Res., 233 North 6th St.), Chillicothe, Ill.

MILLER, VIRGIL WILSON (Jun. '39), 210 Eighth St., Troy, N.Y.

MORGAN, ALFRED KENNETH (M. '39), (Morgan, Hamel & Engelken), 420 Madison Ave., New York, N.Y.

MORRIS, HENRY MADISON, JR. (Jun. '39), Junior Engr., International Boundary Comm., 627 First National Bank Bldg. (Res., 2230 Montana St.), El Paso, Tex.

OBERMULLER, JOHN CHURCH (Jun. '39), Asst. Office Engr., Natomas County of California, Route 3, Box 1355, (Res., 716 Thirty-fourth St.), Sacramento, Calif.

OHANNESIAN, HAROLD (Jun. '39), Draftsman, Lindgren & Swinerton, Inc., Route 2, Box 30 (Res., 1922 Amador St.), Fresno, Calif.

OLSON, NELS EDWIN (Assoc. M. '39), Bridge Designer, State Highway Dept., Highway Bldg., Olympia (Res., 1622 North 9th St., Tacoma), Wash.

ORTIZ, JOSE PULIDO (Assoc. M. '39), Athenaeum, 551 South Hill Ave., Pasadena, Calif.

OSBORN, JOHN EDWARD (Jun. '39), Sales Engr., Am. Concrete & Steel Pipe Co., 4635 Firestone Boulevard, South Gate, Calif.

OSTROM, CHARLES DOUGLAS YELVERTON, JR. (Jun. '39), Instr., Civ. Eng., Univ. of California, 216 Eng. Bldg. (Res., 2624 Hillegass Ave.), Berkeley, Calif.

OSTROTH, GEORGE PAUL (Jun. '39), Junior Engr. (Civ.), War Dept., U.S. Engr. Dept., 209 Pittock Blk. (Res., 1956 North West Everett), Portland, Ore.

PALADINO, PETER ROMEO (Jun. '39), Constr. Engr., The Austin Co., 19 Rector St., New York, N.Y. (Res., 40 Dartmouth St., Pittsburgh, Mass.)

PALMER, CLYDE LUELLEN (Assoc. M. '39), Junior Civ. Engr., City Engrs. Office, City Hall (Res., 1409 Baldwin Ave.), Detroit, Mich.

PALMER, ROBERT THOMAS (Jun. '39), Soils Engr., Portland Cement Assoc., 33 West Grand Ave., Chicago, Ill.

PAPE, HENRY EDWARD, JR. (Jun. '39), Junior Eng. Aid, U.S. Engrs., 405 Sansome St. (Res., 2514 Thirty-second Ave.), San Francisco, Calif.

PATTERSON, ARTHUR PRUDEN (M. '39), State Director, Operations Div., WPA, 149 East

W. V. WEIR—

Superintendent and Chief Engineer of St. Louis County Water Company, University City, St. Louis, Mo., writes:

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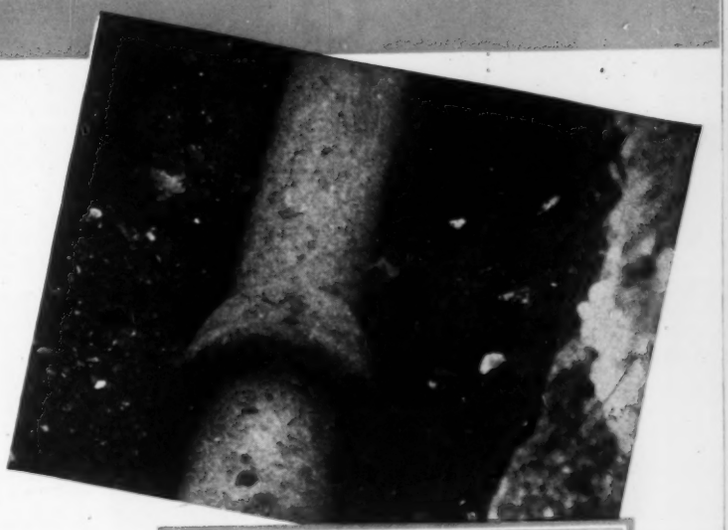

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PEIRCE, WALTER HOWARD (Jun. '39), Graduate Asst., Civ. Eng. Dept., Armour Inst. of Technology, 3300 Federal St., Chicago, Ill.

PIETZ, WESLEY CHARLES (Assoc. M. '39), Dist. Mgr., Raymond Concrete Pile Co., 1501 Union Bank Bldg., Pittsburgh, Pa.

PLATT, NORMAN BRUCE (Jun. '39), Eng. Aid, FCS 8, U.S. Bureau of Reclamation, Paonia, Colo.

POZZO, EDWARD MAX (Jun. '39), 417 Market St., San Francisco, Calif.

RAMSEY, CHARLES WESLEY, JR. (Jun. '39), 2329 Crescent Ave. Extension, Charlotte, N.C.

RASMUSSEN, FRED, JR. (Jun. '39), Junior Engr., U.S. SCS, Box 570, Price, Utah.

REBER, RUDOLPH CARL (Assoc. M. '39), Constr. Supt., E. I. duPont de Nemours & Co., Inc., Belle, W.Va.

REDUS, JOHN FRANKLIN, JR. (Jun. '39), Soils Laboratory Insp., State Highway Dept., Tupelo (Res., Shannon), Miss.

REYNOLDS, JAMES ROBERT (Assoc. M. '39), Asst. Engr., U.S. Engr. Dept., Industrial Trust Bldg., Providence, R.I.

REYNOLDS, KENNETH BURR (Jun. '39), 853 Middlefield Rd., Palo Alto, Calif.

REYNOLDS, LESTER HENRY (Jun. '39), Junior Engr., Trainee, REA, 2000 Massachusetts Ave. (Res., 1750 Massachusetts Ave., N.W.), Washington, D.C.

RICHMOND, BURLEY DAVIS (Jun. '39), Junior Engr., International Boundary Comm., U.S. and Mexico (Res., 335 North Reagan), San Benito, Tex.

RITCHEY, JAMES CLIFTON (Jun. '39), With Development Dept., Firestone Tire & Rubber Co., 225 Firestone Boulevard, Los Angeles (Res., 3236 Louise St., Lynwood), Calif.

ROLLINS, ANDREW PEACH, JR. (Jun. '39), Junior Engr., International Boundary Comm., U.S. and Mexico, Post Office, San Benito, Tex.

ROLLINS, LEIGHTON BOND (Jun. '39), With N. Y. C. R. R., N. Y. C. R. R. Terminal, Weehawken, N.J. (Res., 25 Rodney Rd., Scarsdale, N.Y.)

ROSE, DONALD HAWORTH (Jun. '39), Junior Office Asst., State Highway Dept., Route 3, Box 290, Amarillo, Tex.

RUSH, BENJAMIN GUY, JR. (Jun. '39), Junior Engr., U.S. Engrs., Vicksburg, Miss.

RYBAK, WILLIAM (Jun. '39), Draftsman, Met. Dist. Water Bureau, 1026 Main St., Hartford, Conn. (Res., 422 East 5th St., New York, N.Y.)

SAMARZICH, WARREN NICHOLAS (Jun. '39), Junior Civ. Engr., Barrett & Hilp, 918 Harrison St. (Res., 24 Landers St.), San Francisco, Calif.

SAMUELSON, JACOB AGATHON (Jun. '39), 462 Beacon St., Boston, Mass.

SARGENT, DAVID LEROY (Jun. '39), Graduate Asst., Civ. Eng. Dept., Iowa State Coll. (Res., 247 Hyland), Ames, Iowa.

SAVELLE, MORTON JUDSON (M. '39), State Director, State Geodetic Survey, WPA, 202 Ramsey Hall, Auburn, Ala.

SHINICK GEORGE SYDNEY (Assoc. M. '39), Topographical Draftsman, New York City Tunnel Authority, 200 Madison Ave., New York (Res., 721 East 35th St., Brooklyn), N. Y.

SIMPSON, ROBERT EDWARD (Jun. '39), 309 South Main, Brigham City, Utah.

SLIWA, JOHN PAUL (Jun. '39), Engr., The Highway Corporation, 120 Lister Ave., Newark (Res., 135 Walnut St., Nutley), N.J.

SLOTKIN, MEYER (Jun. '39), Engr., U.S. Engrs., Huntington Dist., Newark, Ohio. (Res., 600 Timpson Pl., New York, N.Y.)

SMITH, JOHN DAVIS (Jun. '39), Rodman and Asst. Engr., Utah Constr. Co., Toston, Mont.

SNETZER, ROBERT ELLIS (Jun. '39), Draftsman, Am. Bridge Co. (Res., 236 Elm Rd.), Ambridge, Pa.

SNYDER, WILLARD MITCHELL (Jun. '39), Junior Engr., U.S. Bureau of Reclamation, 7th and K (Res., 1127 Thirty-ninth St.), Sacramento, Calif.

SORBEL, JOHN LAWRENCE (Assoc. M. '39), Area Engr., WPA, 505 West 4th St., Yankton, S.Dak.

SOUTTER, CHARLES HENRY, JR. (Jun. '39), 2308 Humboldt Ave., South, Minneapolis, Minn.

SPRAGINS, SAMUEL HAMILTON, JR. (Jun. '39), 2622 North Calvert St., Baltimore, Md.

STARKWEATHER, FRED HENRY, JR. (Jun. '39), Care, Federal Power Comm., Hurley-Wright Bldg., Washington, D.C.

STEWART, MORGAN EDGAR (Jun. '39), Eng. Aid, U.S. Engrs., Bryte Bldg. (Res., 2106 E St.), Sacramento, Calif.

STREETER, ROBERT LE ROY (Assoc. M. '39), Engr., Box 359, Gillette, Wyo.

SUBER, LEWIS TERRY, JR. (Jun. '39), Junior Eng. Aide, TVA, Box 137, Waynesville, N.C.

SUNDT, HELMER JACOB (Jun. '39), Junior Engr., U.S. Army Engrs., 628 Pittock Blk. (Res., 1956 North West Everett), Portland, Ore.

SWEET, HAROLD SINCLAIR (Jun. '39), Graduate Research Asst., Joint Highway Research Project, Purdue Univ., Lafayette, Ind.

SWENSON, DONALD DEXTER (Jun. '39), Instrumentman, Northern Natural Gas Co., Aquilla Court Bldg., Omaha, Nebr. (Res., European Hotel, Jackson, Minn.)

SWITZER, ALFRED IVAN (Jun. '39), Care, U.S. Engrs., 751 South Figueroa, Los Angeles, Calif.

TAMMEN, JOHN GEORGE (Jun. '39), Draftsman, Am. Bridge Co., Ambridge (Res., 606 Locust Pl., Sewickley), Pa.

TATE, GUY MORRIS, JR. (Assoc. M. '39), San. Engr., Jefferson County Health Dept., Box 2591, Birmingham, Ala.

TEMBE, NILKANTH RAMCHANDRA (Jun. '39), With the British Reinforced Concrete Co., Queensville (Res., 18, Windsor Rd.), Stafford, England.

THOMAS, GEORGE JOSEPH (Jun. '39), Civ. Engr., Thomas B. Card, Masonic Bldg. (Res., 418 Rivet St.), New Bedford, Mass.

THORNE, MARION FRANCIS (Jun. '39), 422 South Madison, Iowa City, Iowa.

TOWNSEND, JOHN WEAVER (Jun. '39), Res. Engr., Consoer, Townsend & Quinlan, 211 West Wacker Drive, Chicago, Ill. (Res., 1351½ West Grand Ave., Wisconsin Rapids, Wis.)

TOY, FRANK CHUCK (Jun. '39), 124 South Barnard St., State College, Pa.

VALENTE, GEORGE ANTHONY (Jun. '39), 61 Park Ave., Caldwell, N.J.

VECCHIARELLI, FRANCIS (Jun. '39), Eng. Asst., Tunnel Constr., New York City Tunnel Authority, New York (Res., 70 Clinton Ave., Brooklyn), N.Y.

WALTER, BOYD HOWARD (Jun. '39), Junior Engr., U.S. Army Engrs., 628 Pittock Blk. (Res., 333 North West 20th Ave.), Portland, Ore.

WATSON, CLIFFORD WESTERFIELD, JR. (Jun. '39), Insp., Aetna Life Insurance Co., 100 William St., New York, N.Y. (Res., Lincoln Park, N.J.)

WENTWORTH, NATHANIEL NEWCOMB, JR. (Jun. '39), With Fay, Spofford, & Thorndike, 11 Beacon St., Boston (Res., 391 Washington St., Canton), Mass.

WHARTON, THOMAS PARKER (Jun. '39), 3204 Otis St., Mt. Ranier, Md.

WHEATLEY, JOHN PAUL (Jun. '39), Junior Engr., Standard Oil Co., 225 Bush St., Room 454, San Francisco, Calif.

WILKE, HARVEY ROBERT (Jun. '39), Lowry Hall, Columbia, Mo.

WILLIAMS, CLARENCE BENJAMIN, JR. (Jun. '39), 105 Talbot Laboratory, Univ. of Illinois, Urbana, Ill.

WILLIAMSON, GEORGE FREEMAN (Jun. '39), Junior Engr., Housing Authority, St. Thomas St. Project, Annunciation and Felicity Sts. (Res., 7830 Burthe St.), New Orleans, La.

WILLIAMSON, ROBERT OTTO (Jun. '39), 1248 West Waterloo Rd., Akron, Ohio.

WILSON, HARRY (Jun. '39), Junior Engr., U.S. Engr. Dept., Room 1001, Chamber of Commerce Bldg., Pittsburgh, Pa.

WOODALL, LEWIS FREDERICKS (Assoc. M. '39), Engr., Div. of State Parks, 421 State Capitol, Atlanta, Ga.

WOOLF, JAMES MARVIN (Jun. '39), Chainman, Dist. Govt. (Res., 1403 Webster St., N.W.), Washington, D.C.

ZAMBORSKY, ALBERT HUBERT (Jun. '39), Junior Constr. Insp., State Dept. of Highways, 908 Wabash Bldg., Pittsburgh (Res., 25 Jackson St., Rankin), Pa.

MEMBERSHIP TRANSFERS

BEATTY, JOHN MATTHEW (Jun. '30; Assoc. M. '39), Instr., Civ. Eng., Rensselaer Polytechnic Inst., Troy Bldg., Rensselaer Polytechnic Inst. (Res., 44 Excelsior Ave.), Troy, N.Y.

BURNHAM, WALTER CLINTON (Assoc. M. '20; M. '39), 1525 North West 33d St., Oklahoma City, Okla.

CORRADI, PETER (Jun. '37; Assoc. M. '39), Eng. Insp., Grade 4, Board of Water Supply, City of New York, Valhalla (Res., 245 Martine Ave., White Plains), N.Y.

DAVIDSON, HAROLD NILS (Jun. '27; Assoc. M. '39), Structural Engr., Kalamazoo Foundry & Machine Co., 600 East Michigan Ave., Kalamazoo, Mich.

DYER, WESLEY HALLIBURTON (Jun. '35; Assoc. M. '39), Sales Engr., Nashville Bridge Co., Nashville, Tenn.

FURNESS, LAWTON WILLIAMS (Jun. '32; Assoc. M. '39), Asst. Hydr. Engr., Water Resources Branch, U.S. Geological Survey, Federal Bldg., Hartford, Conn.

GARRITY, LEO VALENTINE (Assoc. M. '39; M. '39), Associate Civ. Engr., City of Detroit, 9644 West Jefferson Ave. (Res., 16575 Patton Ave.), Detroit, Mich.

GOFSEYEFF, SAMUEL (Jun. '35; Assoc. M. '39), Junior Engr., U.S. Engr. Office, 39 Whitehall St., New York (Res., 225 Parkside Ave., Brooklyn), N.Y.

GREENBAUM, ERVIN (Jun. '37; Assoc. M. '39), Public Works Engr., State Highway Dept., Lansing (Res., 528 Sunrise Court, East Lansing), Mich.

HERRING, VERNON MAURICE (Jun. '34; Assoc. M. '39), Chf., Placement Div., State Employment Service, 39 Hopkins Pl. (Res., 3304 West North Ave.), Baltimore, Md.

JONES, WILBOURNE OCIE (Assoc. M. '26; M. '39), City Engr., City Hall, Fort Worth, Tex.

KRAMER, ROBERT WILLIAM (Jun. '34; Assoc. M. '39), Asst. Engr., State Highway Dept., Div. 6, Delaware (Res., 90 Blenheim Rd., Columbus), Ohio.

LEWIS, CHARLES EDWARD (Jun. '28; Assoc. M. '39), Asst. Bridge Engr., Bridge Dept., State Highway Comm. (Res., 602 North Euclid Ave.), Pierre, S.Dak.

LICCIONE, DANIEL JOSEPH (Jun. '33; Assoc. M. '39), Senior Civ. Eng. Draftsman, Corps of Engrs., U.S. Army, 196 Spring St., New York, N.Y.

MABBOTT, LYLE WILLARD (Jun. '32; Assoc. M. '39), Research Asst. and Instr., Civ. Eng., Michigan State Coll., East Lansing, Mich.

MANN, JOHN HERBERT CLAIBORNE (Assoc. M. '38; M. '39), Asst. Prof., Civ. Eng., Virginia Military Inst. (Res., 205 Maiden Lane), Lexington, Va.

MORELAND, JAMES EDGAR (Assoc. M. '23; M. '39), Senior Highway Engr., TVA, 115 James Bldg. (Res., 105 South Germantown Rd.), Chattanooga, Tenn.

MURRAY, RAY (Jun. '03; Assoc. M. '07; M. '39), Contr. (R. Murray), Box 164, Moylan, Pa.

POE, HARRY TINKER, JR. (Assoc. M. '08; M. '39), Senior Engr., Santee-Cooper Power and Nav. Project, PWA, 312 Peoples Bldg., Charleston, S.C.

POWELL, FAY EDWIN (Assoc. M. '32; M. '39), Constr. Quartermaster, Panama Canal, Box 275, Balboa Heights, Canal Zone.

QUINN, JOHN DEWEY (Assoc. M. '38; M. '39), Civ. Engr., 117 East 4th Ave., Cheyenne, Wyo.

SCHEER, HENRY OLIVER (Jun. '30; Assoc. M. '39), Maintenance Field Engr., State Div. of Highways, 126 East Ash St., Springfield, Ill.

STEVENS, CHARLES JAMES (Jun. '31; Assoc. M. '39), Asst Engr. (Structural), Bureau of Yards and Docks, Navy Dept., Navy Bldg. (Res., 3521 Hertford Pl., N.W., Apartment 22), Washington, D.C.

TUCKER, HERMAN FRANKLIN (Assoc. M. '04; M. '39), Cons. Structural Engr., 1934 Fourteenth Ave., North, Seattle, Wash.

WHITAKER, GEORGE ELMER, 2d (Jun. '31; Assoc. M. '39), Supervisor of Operations, WPA, 64 Henry St., Binghamton (Res., 4 Hill Ave., Johnson City), N.Y.

REINSTATEMENTS

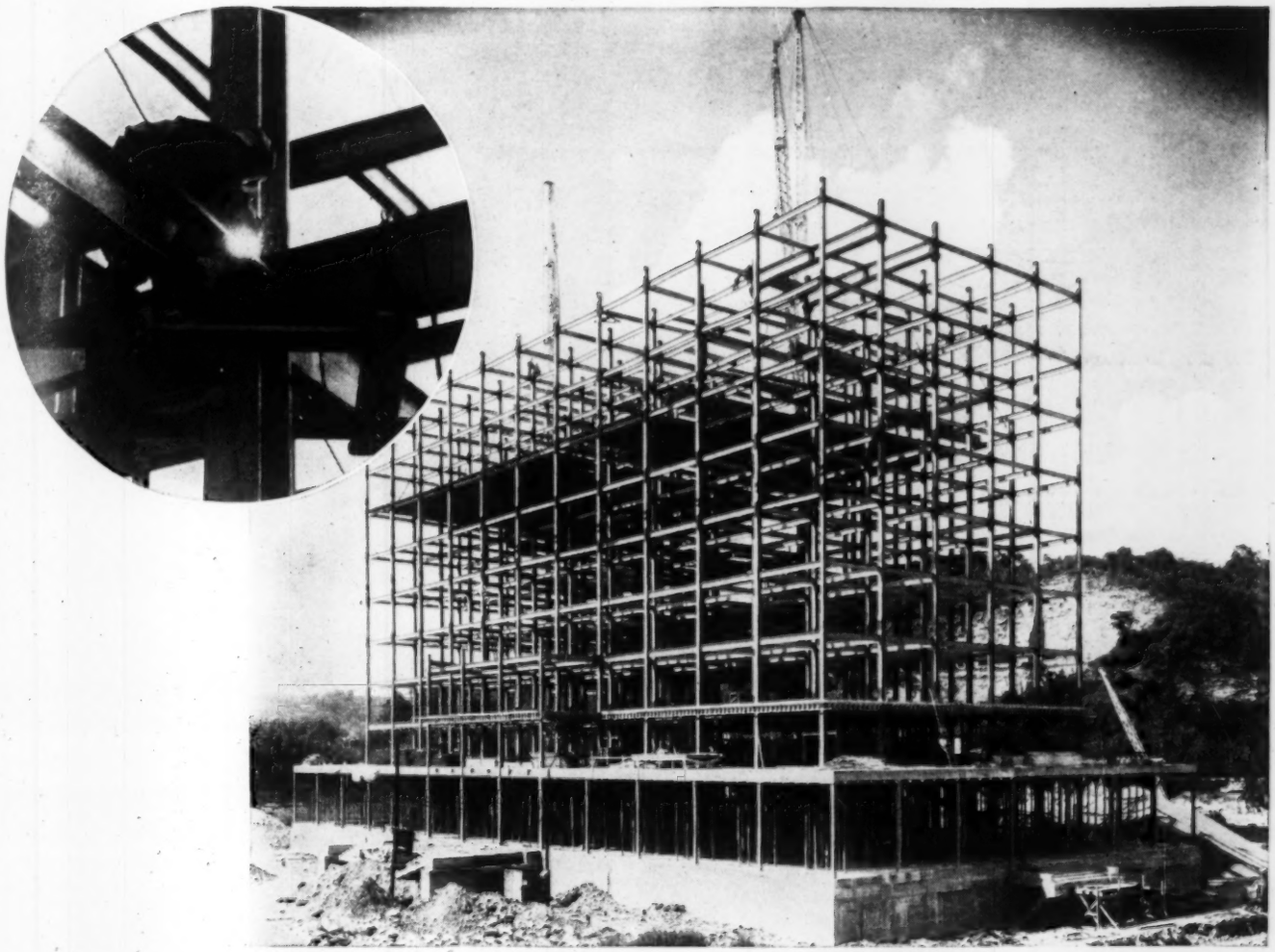
AJWANI, HASHU J., Assoc. M., reinstated Nov. 15, 1939.

HOLMES, HAROLD RISTINE, M., reinstated Nov. 17, 1939.

HULSE, SEWARD WILLIAM, Assoc. M., reinstated Nov. 13, 1939.

RESIGNATIONS

FULLENWIDER, CHARLES VICTOR ROCKWELL, M., resigned Nov. 27, 1939.



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Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

January 1, 1940 NUMBER 1

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

ANSON, EDWARD HIRAM (Assoc. M.), New York City. (Age 37) (Claims RCA 3.3 RCM 8.7) April 1931 to date with Gibbs & Hill, Inc., as Asst. Engr., and Engr. in charge of design, on electrification of Pennsylvania R. R.

BECKHAM, WILLIAM KINSLER, Columbia, S.C. (Age 45) (Claims RCA 2.0 RCM 16.5) June 1920 to date with South Carolina State Highway Dept. as Instrumentman, Draftsman, Chf. of Survey Party, Res. Engr., Div. Engr., Locating Engr. and (since Feb. 1928) Maintenance Engr.

BERMAN, MORRIS, New York City. (Age 42) (Claims RCA 7.5 RCM 8.2) 1930 to date Asst. Engr., Grade 4 (Plan Examiner), Dept. of Housing and Bldgs., also Fire Dept.

EISNER, BENJAMIN, Pittsburgh, Pa. (Age 40) (Claims RCA 2.9 RCM 14.7) Aug. 1939 to date Chf. Engr., Clay Sewer Pipe Association, Inc.; previously San. Engr. and Chf. San. Engr., New York World's Fair; San. Engr., New York City Dept. of Parks; member of firm, Taylor and Eisner, Inc., Newark, Cons. Engrs.

FINCK, HERBERT FERDINAND (Assoc. M.), Brevard, N.C. (Age 44) (Claims RCA 8.3 RCM 7.0) July 1938 to date Civ. and Hydr. Engr., Ecusta Paper Corporation, Pisgah Forest, N.C.; previously Production Mgr., Champagne Paper Corporation, New York City.

FOWLE, ROYAL EDGAR (Assoc. M.), Watsonville, Calif. (Age 40) (Claims RCA 4.9 RCM 8.0) Nov. 1929 to date Engr. and Production Mgr., Granite Rock Co.; also Engr., Central Supply Co. (subsidiary); private practice.

GOULD, EDWARD CAUVET, Minneapolis, Minn. (Age 35) (Claims RCA 1.0 RCM 5.2) July 1938 to date with City of Minneapolis as Senior Civ. Engr. (Structural), and (since Oct. 1939) Senior Archt. Engr.; previously with Minnesota State Highway Dept. as Material Inspector and Field Draftsman.

HICKS, HERBERT SCOBLE, Detroit, Mich. (Age 42) (Claims RCA 7.0 RCM 10.0) 1931 to date with Jerome A. Utley, Contr. Engr. as Estimator, and (since 1933) Supt.

HOLDEN, OTTO, Toronto, Ont., Canada. (Age 48) (Claims RCA 3.0 RCM 21.3) Aug. 1913 to date with Hydro-Elec. Power Comm. of Ontario as Draftsman, Designing Engr., Engr. of Design, Asst. Hydr. Engr., Deputy Head of Dept., and (since Nov. 1937) Chf. Hydr. Engr.

JAMES, RUSSELL WALKER (Assoc. M.), Denver, Colo. (Age 44) (Claims RC 15.2 D 15.2) May 1928 to date Associate Highway Bridge Engr., Bureau of Public Roads, U.S. Dept. of Agriculture.

KNOERLE, JOSEPH KARL (Assoc. M.), Baltimore, Md. (Age 43) (Claims RCA 8.2 RCM 6.7) Jan. 1928 to date with The J. E. Greiner Co. as Asst. Res. Engr., Draftsman, Engr., and (since Dec. 1934) Res. Engr., Designer and Project Engr.

LAMB, JOHN FEREBEE (Assoc. M.), El Centro, Calif. (Age 48) (Claims RCA 6.9 RCM 7.6) 1923 to date with Imperial Irrigation Dist. as Draftsman, Transitman, Structure Foreman, Constr. Supt., and (since 1937) Field and Drainage Engr.

LIUM, ELDER LEONARD, Grand Forks, N.Dak. (Age 43) (Claims RCA 6.4 RCM 11.7) March 1936 to date with Univ. of North Dakota as Asst. Prof. of Civ. Eng., and (since Sept. 1939) Associate Prof. and Head of Civ. Eng. Dept. of Coll. of Eng.; also March 1936 to date Cons. Engr., since Nov. 1937 in partnership with L. W. Burdick; previously City. Engr., Grand Forks, N.Dak.

MCCORDIC, GEORGE WILFRID, Detroit, Mich. (Age 40) (Claims RC 14.3 D 6.2) Oct. 1933 to Nov. 1937 and Jan. 1938 to date with WPA as Engr. Examiner, Chf. Engr. and (since Jan. 1938) Project Engr.; in the interim San. Engr., Wayne County (Mich.) Road Comm.

PIERCE, ROBERT ELLIOTT, Stockton, Calif. (Age 54) (Claims RCA 2.3 RCM 15.3) March 1926 to July 1928 Acting Dist. Engr., and July 1928 to date Dist. Engr., California State Div. of Highways.

REEDER, EARL JOHN, Evanston, Ill. (Age 49) (Claims RCA 10.6 RCM 13.0) Dec. 1923 to date with Public Safety Div., National Safety Council, Chicago, Ill., as Engr., Superv. Engr., Traffic Engr., and (since Oct. 1936) Chf. Traffic Engr.

RENN, RAYMOND WILLIAM (Assoc. M.), Cincinnati, Ohio. (Age 44) (Claims RCA 5.9 RCM 9.2) Sept. 1928 to July 1932 Asst. Prof., and July 1932 to date Associate Prof., Dept. of Coordination, Univ. of Cincinnati; Feb. 1919 to date with Officers Reserve Corps, U.S. Army, since 1933 as Major.

RHEINSTEIN, ALFRED (Assoc. M.), New York City. (Age 50) (Claims RCA 1.2 RCM 23.3) Dec. 1937 to date Chairman, New York City Housing Authority; also Dec. 1937 to July 1939 Commr., Housing and Bldgs.; since July 1939 Director of Public Housing, New York City; previously with Rheinstein Constr. Co., Inc., New York City.

ROBINSON, CLINTON FREDERICK, New York City. (Age 37) (Claims RCA 2.4 RCM 8.7) Sept. 1924 to Sept. 1925, June 1926 to July 1927, and March 1929 to date with Corps of Engrs., U.S. Army on WPA work, New York City, as Asst. to Chf. Engr., Deputy Director of Operations, and (since April 1939) Director of Operations; previously on surveys, Nicaragua and Panama, etc.

ROETTIGER, EMMONS LORENZ, Madison, Wis. (Age 39) (Claims RC 13.8 D 12.1) June 1921 to date with Wisconsin State Highway Comm. as Inspector, Chf. of Party, Res. Engr., Asst. Div. Engr., Asst. Constr. Engr., Constr. Engr., and (since June 1935) State Highway Engr.

RUSSELL, WILFORD BATES, Birmingham, Mich. (Age 41) (Claims RCA 2.3 RCM 13.0) Jan. 1936 to date Asst. Secy. and Chf. Engr., Peerless Cement Corporation, Detroit, Mich.; previously in private practice.

SANDERS, AZEL LABON RALPH (Assoc. M.), Chicago, Ill. (Age 41) (Claims RCA 6.0 RCM 8.4) Sept. 1936 to date Asst. Engr., Hazelet & Erdal, Cons. Engrs.; previously Structural Engr., Board of Local Improvements.

SANTACRUZ, ARMANDO, JR. (Assoc. M.), Mexico, D.F., Mexico. (Age 39) (Claims RCA 3.0 RCM 15.7) Nov. 1939 to date Eng. Asst. to Secy. of Communications and Public Works of Mexico; previously Engr. Coordinator of City Planning for Comms. of several cities in Mexico; Superv. Engr., Federal Irrigation Projects, Federal Land and Agricultural Bank of Mexico; Commr. for Mexico on International Boundary and Water Comms., United States and Mexico.

SNODERLY, MURPHY ULYSSES (Assoc. M.), Johnson City, Tenn. (Age 40) (Claims RCA 10.3 RCM 8.2) June 1939 to date City Mgr.; previously Dist. Engr., TERA, Dist. Supervisor of Operations, WPA, and Asst. Engr. on Administrative Staff; Gen. Mgr., Nashville Board of Park Commrs.; Res. Engr., C. N. Harrub Eng. Co., Owenton, Ky.

SPRING, VALENTINE FISHER, Philadelphia, Pa. (Age 50) (Claims RCA 13.2 RCM 4.7) July 1918 to date with U.S. Engr. Office as Jun. Engr., Asst. Engr., Associate Engr., and (since April 1938) Engr., being Chf. of Tech. Div., in responsible charge of Div.

SUHR, LEWIS DELMAR, Evanston, Ill. (Age 46) (Claims RCA 9.0 RCM 11.0) 1924 to 1933 and 1937 to date member of firm, Suhr, Berryman, Peterson & Suhr; in the interim Asst. State Director of operations and Chf. Planning Engr., WPA, Illinois Dist. No. 3; Chf. Engr., Water Resources Sec., Illinois State Plan Comm.

APPLYING FOR ASSOCIATE MEMBER

ADCOCK, ANDREW JACKSON, Van Horn, Tex. (Age 65) (Claims RCA 32.4 RCM 0.0) Jan. 1921 to Nov. 1925 and June 1928 to date with Texas State Highway Dept. as Res. Engr., and (since June 1938) Senior Res. Engr.; in the interim in private practice.

BELL, WILLIAM HENRY, Rolla, Mo. (Age 29) (Claims RC 7.2 D 5.9) Feb. to July 1935 Recorder, and Jan. 1939 to date Jun. Topographic Engr., U.S. Geological Survey; in the interim Project Engr., WPA, Fort Smith, Ark.; Res. Engr., successively with Hugh R. Carter, Engr., Little Rock, Ark., and W. Horace Williams Co., Inc., Engrs. and Contrs., New Orleans, La.

BERRIGAN, PAUL DUNN, Portland, Ore. (Age 34) (Claims RCA 9.0 RCM 1.3) June 1927 to

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date with Corps of Engrs., U.S. Army, as 2d Lieut., 1st Lieut., and (since Aug. 1938) Capt.

BITTNER, SAMUEL EDGAR, JR., Tionesta, Pa. (Age 37) (Claims RCA 3.5 RCM 0.0) April 1925 to March 1927 and April 1935 to date with U.S. Engr. Corps. as Inspector, Res. Engr., and (since May 1936) Asst. Res. Engr.; in the interim Project Engr., CWA and New Jersey ERA; Inspector, Pittsburgh Testing Laboratory; Tech. Service Engr., Universal Atlas Cement Co.

BLAIR, PAUL MCCREARY (Junior), Silver Spring, Md., (Age 32) (Claims RCA 6.3 RCM 1.4) Nov. 1938 to date with Federal Power Comm., Washington, D.C., as Asst. Engr., and (since Nov. 1939) Associate Engr.; previously Jun. Engr., U.S. Engrs.

BLISS, PERCY HENRY (Junior), Little Rock, Ark. (Age 32) (Claims RC 5.8 D 4.1) Oct. 1936 to date Jun. Engr., U.S. Engr. Dept.; previously Cons. Engr., successively with Taft-Nelscott-Delake Water Dist.; and Taft (Ore.) San. Dist.; Prof. of Civ. Eng., Oregon Inst. of Technology.

BONDURANT, DONALD CONNALLY, Caddoa, Colo. (Age 31) (Claim RCA 7.2 RCM 0.0) Sept. 1931 to Nov. 1935 and Dec. 1935 to date with U.S. Engr. Office as Chf. Inspector, Jun. Engr., and (since June 1939) Asst. Engr.

BRADFORD, WILLIAM HARLOW (Junior), Augusta, Me. (Age 32) (Claims RCA 5.0 RCM 0.0) June 1927 to date with Maine State Highway Comm. as Bridge Inspector, Bridge Draftsman, and (since Jan. 1932) Jun. Engr.

BRUMER, MILTON, Harrisburg, Pa. (Age 37) (Claims RCA 3.2 RCM 10.9) Aug. 1938 to date Engr. of tunnel design, Pennsylvania Turnpike Comm.; previously Asst. Engr., Port of New York Authority, New York City.

CAWLEY, CLIFFORD COMER (Junior), Los Angeles, Calif. (Age 29) (Claims RC 3.4 D 3.4) Dec. 1933 to April 1938 with Design Office, Los Angeles County Flood Control Dist. as Senior Draftsman and (one year) Design Engr.; 2d Lieut., Engr. Reserve, U.S. Army.

CHAMPAGNE, RALPH GEORGE, Little Falls, N.Y. (Age 37) (Claims RC 4.6 D 1.2) Jan. 1937 to date with The Callanan Road Improvement Co., South Bethlehem, N.Y., as Chf. Engr., Asst. Supt. and Supt.; previously Asst. Hydr. Engr., New York State Planning Board, Albany, N.Y.; Sales Engr., Timken Detroit Axle Co., Albany Office.

CHENWORTH, CHARLES FRANCIS (Junior), Washington, D.C. (Age 32) (Claims RCA 2.0 RCM 0.0) Aug. 1930 to date with U.S. Coast & Geodetic Survey as Jun. Engr., and (since July 1932) Aid, acting as Jun. Officer.

COOK, RUDYARD MERWIN, State College, N.Mex. (Age 30) (Claims RCA 1.2 RCM 0.0) Jan. 1939 to date Instructor, Dept. of Civ. Eng., New Mexico State Coll.; previously with Odisco Corporation, Chicago, as Asst. on promotion and development of new products; previously Asst., Rail and Rail Fastenings Dept., R. W. Hunt Co., Chicago, Ill.; Inspector, U.S. Army Engr. Corps.

CORSER, CHAMP ELKINS (Junior), Seattle, Wash. (Age 32) (Claims RCA 2.3 RCM 0.0) Sept. 1937 to date Bridge Designer with Washington State Dept. of Highways, Olympia, and (since Jan. 1939) Washington Toll Bridge Authority, Seattle; previously with City of Seattle as Structural Designer, Bridge Dept., and in City Light Dept.; Estimator on new work, The Austin Co.

CROSSLEY, NIXON FRANK, San Pedro, Calif. (Age 30) (Claims RC 8.0) Nov. 1935 to date with Metropolitan Water Dist. of Southern California as Asst. Engr., Asst. Res. Engr., and (since Dec. 1938) Res. Engr.; previously with U.S. Bureau of Reclamation as Inspector and Associate Engr.

CROWTHER, JAMES IRVING, Baltimore, Md. (Age 30) (Claims RCA 1.3 RCM 0.0) Sept. 1938 to date Staff Engr., Comm. on Governmental Efficiency and Economy; previously Chemist (Water Analyst), U.S. Public Health Service; San. Engr., West Virginia State Health Dept., Charleston, W.Va.

DEADY, WAYNE J., Turlock, Calif. (Age 37) (Claims RCA 7.4 RCM 3.0) Sept. 1926 to date with California State Div. of Highways, Bridge Dept., Sacramento, as Asst. to Res. Engr., Res. Engr., and at present Associate Bridge Engr.

ELLIOTT, EDWIN ASHLEY, Kansas City, Mo. (Age 27) (Claims RCA 2.3 RCM 0.0) March 1934 to date Civ. Engr., Burns & McDonnell Eng. Co.

GETZ, MURRAY AUSTIN (Junior), Omaha, Nebr. (Age 32) (Claims RCA 2.5 RCM 0.0) Jan. to June 1939 Jun. Engr. Inspector, and June 1939 to date Asst. Engr., PWA; previously Eng. Aide and Jun. Engr., U.S. Bureau of Agricultural Eng.; Asst. Engr., Appraisal Dept., Black & Veatch, Engrs., Kansas City, Mo.

HAINES, REUBEN MATTER (Junior), Concord, N.H. (Age 32) (Claims RCA 4.4 RCM 0.0) Aug. 1935 to date with U.S. Engr. Office as Asst. Engr., and (since Oct. 1938) Associate Engr. in charge of Soils Investigation Sec.

HARRINGTON, EDWIN LINCOLN, College Station, Tex. (Age 38) (Claims RCA 5.8 RCM 0.0) Sept. 1939 to date Instructor in Civ. Eng., Texas Agricultural and Mechanical Coll.; previously with Missouri State Highway Dept., Joplin, Mo., as Slab Inspector, Instrumentman, Asst. Project Engr., Project Engr., and Jun. Engr.

HECKLER, WILBUR LEROY (Junior), Tucson, Ariz. (Age 32) (Claims RCA 5.6 RCM 0.0) June 1929 to date with Water Resources Branch, U.S. Geological Survey as Jun. Hydr. Engr., Res. Jun. Hydr. Engr., and (since March 1935) Asst. Hydr. Engr.

HESTER, JAMES TAYLOR (Junior), San Francisco, Calif. (Age 32) (Claims RCA 1.9 RCM 0.0) July 1938 to date Asst. Engr., California Joint Highway Dist. No. 10 (San Francisco and San Mateo Counties); previously Jun. Hydr. Engr., San Francisco Water Dept.

HUBER, CHARLES EDWARD, Baltimore, Md. (Age 53) (Claims RCA 8.5 RCM 2.0) Feb. 1935 to July 1937 and Jan. 1938 to date with War Dept., U.S. Engr. Office, as Designer and Associate Engr.

HULICK, DAN, Washington, D.C. (Age 57) (Claims RCA 23.4 RCM 12.2) May 1939 to date San. Engr., U.S. Housing Authority; previously County Engr., Greenville County, S.C.; Bldg. Inspector, PWA Housing Project, Charleston, S.C.; Res. Engr. Inspector, PWA, Walterboro, S.C.

KOHL, JOHN CLAYTON (Junior), Pittsburgh, Pa. (Age 31) (Claims RCA 2.1 RCM 0.0) March 1939 to date Laboratory Director, Pittsburgh Corning Corporation; previously with Pittsburgh (Pa.) Plate Glass Co., as Development Engr., and Asst. Director, Central Development Laboratory; Instructor in Civ. Eng., Carnegie Inst. of Technology.

LANGBEIN, WALTER BASIL (Junior), Washington, D.C. (Age 32) (Claims RCA 5.4 RCM 0.0) June 1935 to date with U.S. Geological Survey as Jun. Engr., Asst. Engr., and (since June 1939) Associate Engr.; previously with Rosoff Subway Constr. Co. as Rodman, Eng. Asst., Instrumentman, and Asst. Engr.

POLISSON, PAUL ANGEL (Junior), Gloucester, Mass. (Age 32) (Claims RCA 5.3 RCM 0.0) March 1935 to date Civ. Engr., and City Engr., Gloucester, on all municipal engineering; previously Civ. Engr., ERA Administrator, being Superv. Engr. on Planning Board projects.

QUADE, CHARLES OMAR (Junior), Denison, Tex. (Age 32) (Claims RCA 3.2 RCM 1.0) Oct. 1933 to date with U.S. Engr. Office as Inspector, Office Engr., Designer, and (since Oct. 1938) Associate Engr.

QUINN, GUSTAVE GENIN, Lake Charles, La. (Age 34) (Claims RCA 1.5 RCM 7.3) Oct. 1935 to date Structural Designer, Dunn & Quinn, Archts. & Engrs.; previously Dist. Reconditioning Supervisor, HOLC; Asst. Engr., Lake Charles (La.) Harbor & Terminal Dist.

RIDDICK, THOMAS MOORE (Junior), New York City. (Age 32) (Claims RCA 2.1 RCM 3.0) Dec. 1936 to date Cons. Engr. and Chemist; previously Chemist and Bacteriologist with Nicholas Hill Associates; Instructor, New York Univ.

RUPP, VERNON WARD, Asheville, N.C. (Age 35) (Claims RC 3.1) March 1928 to date with U.S. Geological Survey as Jun. and Asst. Engr.

SHAW, GEORGE REED (Junior), Troy, N.Y. (Age 32) (Claims RCA 1.2 RCM 0.0) June 1927 to Oct. 1938 Instructor, and Oct. 1938 to date Asst. Prof., Dept. of Geodesy and Transportation Eng., Rensselaer Polytechnic Inst.

SJOBERG, HAROLD OLIVER (Junior), Oakland, Calif. (Age 32) (Claims RCA 10.2 RCM 0.0) April 1939 to date Structural Designer with Jas. M. Smith (2 months), and The Austin Co.; previously Structural Eng. Associate, California Comm., Golden Gate International Exposition; Jun. Bridge Engr., Asst. Bridge Engr., and Associate Engr., San Francisco–Oakland Bay Bridge.

STIMPSON, CLARENCE AMOS, Ann Arbor, Mich. (Age 55) (Claims RCA 10.3 RCM 5.4) Oct. 1926 to date Senior Engr., Jensen, Bowen & Farrell.

STINSON, ORVIS DANIEL (Junior), Charlotte, N.C. (Age 31) (Claims RC 1.0 D 2.7) July 1939 to date Estimator, J. A. Jones Constr. Co.; previously Estimator and Sales Engr., Southern Eng. Co.; Asst. Res. Engr., Georgia Highway Board, Augusta, Ga.

STUBLER, ANDREW JAMES (Junior), Baltimore, Md. (Age 32) (Claims RCA 0.0 RCM 2.3) June 1939 to date Supt.-Engr. with S. B. Dove, Gen. Contr.; previously Field Engr., successively with Compania Consolidada de Petroleo, Caracas, Venezuela, and H. Clay Primrose, Landscape Archt.; Chf. of Party, New York World's Fair; Concrete Foreman, Cerro de Pasco Copper Corporation, Oroya, Peru; Constr. Foreman, Pennsylvania R. R. electrification.

WICKER, CLARENCE FELTON, Philadelphia, Pa. (Age 32) (Claims RCA 7.6 RCM 0.0) July 1929 to date with U.S. Engr. Office as Surveyman, Jun. Engr., Asst. Engr., and (since Aug. 1939) Associate Engr., in charge of Research and Special Studies Sec. of office.

WURZ, ARNOLD (Junior), Clarksdale, Miss. (Age 32) (Claims RCA 5.2 RCM 0.0) July 1935 to date Asst. Engr. (Camp Supt.), U.S. Dept. of Agriculture SCS, CCC; previously Inspector of Dredging, Memphis Engr. Dist., 3d Field Area, Helena, Ark.

APPLYING FOR JUNIOR

BOOK, JOSEPH EMANUEL, Pittsburgh, Pa. (Age 26) 1939 B.S. in C.E., N.Y. Univ.; Oct. 1939 to date Jun. Engr., War Dept., U.S. Engrs.

CASTER, ARTHUR DAWSON, New Castle, Ind. (Age 29) (Claims RCA 3.6 RCM 0.0) Oct. 1939 to date Supt. of New Castle sewage-treatment works, in complete charge of operation; previously Field Engr. with Charles H. Hurd, Cons. Engr.; Non-Relief Engr. for WPA, on roadwork, bridge, sewers; Asst. Supt. and Engr., Lundoff-Bicknell Constr. Co., Cleveland, Ohio; Engr., Indianapolis Rys. Co.

COLBY, LESLIE ELDRIDGE, Parris Island, S.C. (Age 28) (Claims RCA 2.1 RCM 0.0) June 1939 to date Asst. Project Mgr., U.S. Navy; previously Senior Project Engr., WPA; Jun. Civ. Engr., U.S. Federal Power Comm.; Draftsman, Designer, and Civ. Engr., Elgin, Joliet & Eastern Ry. Co.

COUSAR, HUGH CHARLTON, JR., Mobile, Ala. (Age 25) (Claims RCA 1.2 RCM 0.0) Feb. to Sept. 1937 Jun. Eng. Aid, and Oct. 1938 to date Jun. Engr., U.S. Engr. Dept.; in the interim Jun. Eng. Aid, and Asst. Eng. Aid, U.S. Waterways Experiment Station, Vicksburg, Miss.; previously Inspector, Northeastern Div., South Carolina Highway Dept.

CRAWFORD, RAYMOND ROPER, Gardena, Calif. (Age 28) 1939 B.S. in C.E., Univ. of So. Calif., Oct. 1939 to date Lightkeeper on triangulation, U.S. Coast and Geodetic Survey.

CUNNINGHAM, PHILIP EDWARD, Milwaukee, Wis. (Age 23) 1939 B.C.E., Marquette Univ.; June 1939 to date Eng. Aide, Federal Government, WPA, acting as Estimator.

CURRY, THOMAS SHERROD, JR., El Paso, Tex. (Age 29) (Claims RCA 0.7) Jan. 1934 to date Draftsman, International Boundary Comm., United States and Mexico, U.S. Sec.

DANIELS, WARREN SIDNEY, University, La. (Age 27) (Claims RCA 1.0) July 1937 to date Jun. Hydr. Engr., U.S. Geological Survey; previously Senior Civ. Eng. Aide, U.S. Engr. Office, Mobile, Ala.; Topographic Draftsman, U.S. Army Engrs., 2d New Orleans Dist.; Rodman, Recorder, and Observer, U.S. Coast and Geodetic Survey.

DOOLITTLE, EDWARD JENKINS, JR., Puerto Cabezas, Nicaragua, C.A. (Age 30) 1938 B.S. in Civ.Eng., and 1939 B.S. in Commerce, Drexel Inst. Tech.; La Luz Mines, Ltd.

FERBER, ROBERT ARNOLD, Hackensack, N.J. (Age 21) 1939 B.S. in Civ. Eng., Univ. of Pa.; June 1939 to date Detailer, American Bridge Co., preparing shop detail drawings.

GROSS, SEYMOUR, Winthrop, Mass. (Age 24) (Claims RC 1.3 D 0.3) 1938 S.B., Mass. Inst. Tech.; Oct. 1939 to date Senior Eng. Aide, Metropolitan Dist. Comm.; previously with Gross & Co. as Supervisor of building alterations, etc.

KEYAK, MICHAEL HENRY, San Francisco, Calif. (Age 25) (Claims RC 0.1 D 0.5) 1939 B.S. in Civ. Eng., Univ. of Calif.; Oct. 1939 to date Jun. Eng. Aide, Flood Control Sec., U.S. Engrs.

LAWRENCE, RAY GOODMAN, Palmyra, Nebr. (Age 24) 1939 B.S. in C.E., Univ. of Kans.; Aug. 1939 to date Job. Engr., Fluor Corporation, Constrs. and Engrs.

PATTERSON, DEE ALDEN, Kansas City, Kans. (Age 22) 1939 B.S. in C.E., Univ. of Kans.

PETERSON, THOMAS HUGH, Portland, Ore. (Age 29) (Claims RCA 1.2) Dec. 1935 to Feb. 1938 and Feb. 1939 to date with U.S. Engr. Office as Topographic Draftsman, Jun. Engr., Chf. of Party, and (since May 1939) Asst. Engr.; in the interim Jun. Engr., U.S. Bureau of Reclamation; previously with U.S. Forest Service.

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PORTER, NORMAN, New York City. (Age 24) 1939 B.C.E., Coll. of City of N.Y.

SCHEID, PAUL GEORGE, Milwaukee, Wis. (Age 22) 1939 B.C.E., Marquette Univ.; July 1939 to date Asst. Engr., Great Lakes Dredge & Dock Co., being Asst. to Div. Engr.

SHERMER, CARL LOUIS, Tiffin, Ohio. (Age 29) April 1935 to Dec. 1937 with U.S. Gypsum Co., Chicago, Ill., on clerical work, structural design, and drafting.

SPENCER, THOMAS FURMAN, Columbus, Ohio. (Age 24) 1937 B.A. Swarthmore Coll., 1939 M.S. in Civ. Eng., Ohio State Univ.; Aug. 1937 to date with Bureau of Tests, Ohio Dept. of Highways as Bituminous Material Inspector, and (since Oct. 1939) Asst. Engr.

STANLEY, JOSEPH ANDREW, JR., Pecos, Tex. (Age 24) 1939 B.S. in Civ. Eng., Tex. Tech. Coll.; Sept. 1939 to date Jun. Office Asst., Texas Highway Dept., drafting and general office work.

THOMASSON, HORACE GORDON, JR., Ft. Smith, Ark. (Age 28) Aug. 1936 to date Jun. Hydr. Engr., U.S. Geological Survey; previously Student Highway Engr., U.S. Bureau of Public Roads, Div. of Parks and Forests; Rodman and Inspector, Arkansas State Highway Dept.

VANDERSLOOT, PETER RALPH, Malden, Mass. (Age 25) 1938 B.S. in C.E., Northeastern Univ.; June 1939 to date Eng. Draftsman, Stone & Webster Eng. Corporation, Boston, Mass.; previously Draftsman, Metropolitan Dist. Water Supply Comm., Boston, Mass.; Structural Steel Detailer, New England Structural Co., Everett, Mass.

The Board of Direction will consider the applications in this list not less than thirty days after date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 125 of the 1939 Year Book of the Society. To expediate publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

DESIGN

STRUCTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; 36; M.Sc., Massachusetts Institute of Technology; assistant instructor one year; 13 years on design of suspension bridge, two-hinged arch bridge, plate girder bridges; reinforced concrete arches, rigid frames, retaining walls, and vehicular tunnels, both subaqueous and mountain. Now employed. Location immaterial. C-632.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; graduate; 14 years designing and supervision of design, estimates, and construction of highway and railroad bridges of reinforced concrete and steel, including continuous trusses, concrete arches, rigid frames, raising and alterations to existing bridge. Available on two weeks notice as engineer of design. C-633.

EXECUTIVE

MECHANICAL-STRUCTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; technical education; registered in New York State; 20 years experience in power and industrial plants—design, maintenance, and construction; foundations, steel structures, mechanical handling, general plant equipment. C-623.

STRUCTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; 39; B.S. in C.E.; New Jersey license; 12 years investigation, design, estimating, and supervision of construction of reinforced concrete, stone masonry, and steel bridges; 6 years general engineering practice; desires responsible position. C-625.

CIVIL ENGINEER; M. Am. Soc. C.E.; 12 years with two of the country's best heavy engineering construction firms. Has gained familiarity with structures through years of field supervision but gained, simultaneously, sense of theory and values through constant estimating and bidding. Wishes opportunity with consulting engineer, or position as estimator. C-626.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; licensed, state of Virginia; 30 years experience, land surveys, topography, railroads, water supply, sewerage, drainage, flood control, irrigation, etc., for government and other concerns. Location preferred, Washington, D.C., or Texas. Will consider other localities. C-628.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 50; married; graduate; 30 years experience including irrigation, railroad valuation, city surveying, hydraulic engineer, water-rights port construction, heavy concrete building construction, and 13 years as sales engineer and mechanical engineer. Available at once. Location preferred, West Coast. C-634-383-D-4-San Francisco.

JUNIOR

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 22; single; B.S.C.E.; Manhattan College, 1938; 6 months assistant civil engineer on reinforced concrete bridge construction; 9 months junior engineer on highway construction. Falsework design; minor supervision; estimating in R. C. construction and highway work. Available immediately; location immaterial. C-622.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 23; married; graduate of Georgia School of Technology, B.S.C.E., 1937; 6 months assistant engineer on street railway; 2 years responsible field laboratory work—soil, concrete, asphalt; employed at present; desires stable opening in steel, concrete design, or sanitary engineering. C-629.

MISCELLANEOUS

MUNICIPAL ENGINEER; Assoc. M. Am. Soc. C.E.; graduate; N.J. state licensed engineer and land surveyor; 25 years experience in municipal engineering, specializing in sewer and disposal design and construction. Recently in sewage design and construction at World's Fair. C-630.

TEACHING

CIVIL ENGINEER, M. Am. Soc. C.E.; 48; B.S., C.E., and M.S.; 13 years successful teaching (one university); 10 years practical experience (field, office, and administrative); at present in charge of half-million-dollar bridge program. C-624.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 32; B.S.C.E.; M.S. (geology); licensed professional engineer, land surveyor, New York state; 12 years experience design, theoretical analysis, construction, and administration of extensive engineering projects; instructor in civil engineering subjects, evening division metropolitan university; desires responsible position with consultant or contractor, or as assistant professor in engineering college. C-627.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 115 of the Year Book for 1939. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

BOECKH'S MANUAL OF APPRAISALS, 3 ed. revised and enlarged. By E. H. Boeckh. Indianapolis, Ind., Rough Notes Co., 1937. 399 pp., illus., diagrs., charts, tables, 9 × 6 in., leather, $6 for manual; $9.50 for manual and tables.

The opening section describes briefly appraisal systems, the Boeckh index control for local cost figures, and the practical use of the manual. Part 2 gives structural base costs for more than a hundred types of buildings; Part 3 discusses appraisal analysis; and Part 4 is concerned with land valuation. Tax information, building nomenclature, and construction requirements are appended.

(THE) CONSTRUCTION OF NOMOGRAPHIC CHARTS. By F. T. Mavis. Scranton (Pa.), International Textbook Co., 1939. 132 pp., diagrs., charts, tables, 8½ × 5 in., fabrikoid, $2.

This textbook provides a practical course for engineers and advanced undergraduate students. The theory of logarithms, the slide rule, and functional coordinate papers is discussed. Many examples of nomogram construction are included.

HUMAN-RELATIONS MANUAL FOR EXECUTIVES. By C. Heyel. New York and London, McGraw-Hill Book Co., 1939. 253 pp., diagrs., charts, tables, 8 × 5 in., cloth, $2.

Hundreds of ideas for selecting, developing, stimulating, safeguarding, and guiding the working force are presented in the form of case examples of what actual companies are doing successfully to solve their personnel problems. Application check points, consisting of pertinent questions on the preceding material, accompany each chapter.

SEVEN PLACE NATURAL TRIGONOMETRICAL FUNCTIONS. By H. C. Ives. New York, John Wiley & Sons, 1939. 222 pp., diagrs., charts, tables, 7 × 4 in., cloth, $2.50.

These tables have gone into a second printing, in which certain revisions have been made, particularly in the tables for the time of culmination and elongation of Polaris. The book provides a compact collection for field and office use by surveyors, especially with calculating machines.

SPANNUNGSOPTIK. By G. Mesmer. Berlin, J. Springer, 1939. 222 pp., illus., diagrs., charts, tables, 9½ × 6 in., cloth, 30 rm.; paper, 28.50 rm.

This book is intended as a concise introduction to the methods for the photoelastic study of stresses and to their practical uses in engineering. The fundamental mathematical derivations for stresses in a plane are worked out; the apparatus and methods for different processes are described and evaluated; dynamic and three-dimensional problems are briefly considered; and illustrated examples of actual work are presented. There is a large bibliography.

(THE) THEORY OF STRUCTURES, 4 ed. By C. M. Spofford. New York and London, McGraw-Hill Book Co., 1939. 615 pp., diagrs., charts tables, 9 × 6 in., cloth, $6.

The design of fundamental structural elements, restricted to statically determined cases, is presented in a thorough, logical manner. Topics covered include beams, girders, trusses, cantilevers, columns, arches, joints, movable bridges, and dams, with general discussion of forces, reactions, loads, deflections, and space frameworks. There are problems and references with each chapter. This edition has been revised in accordance with recent structural engineering developments.

WROUGHT IRON—Its Manufacture, Characteristics and Applications, 2 ed. By James Aston and Edward B. Story. Pittsburgh (Pa.), A. M. Byers Company, 1939. 97 pp., illus., tables, diagrs., charts, 9 × 6 in., cloth, $1.

This interesting volume provides up-to-date information on wrought iron for all who are interested in problems of material selection as well as for students who may some day become responsible for engineering specifications. The history of wrought-iron manufacture is given in brief, and numerous photographs illustrate the various phases of the manufacturing process.

What are the Facts about LEAKAGE

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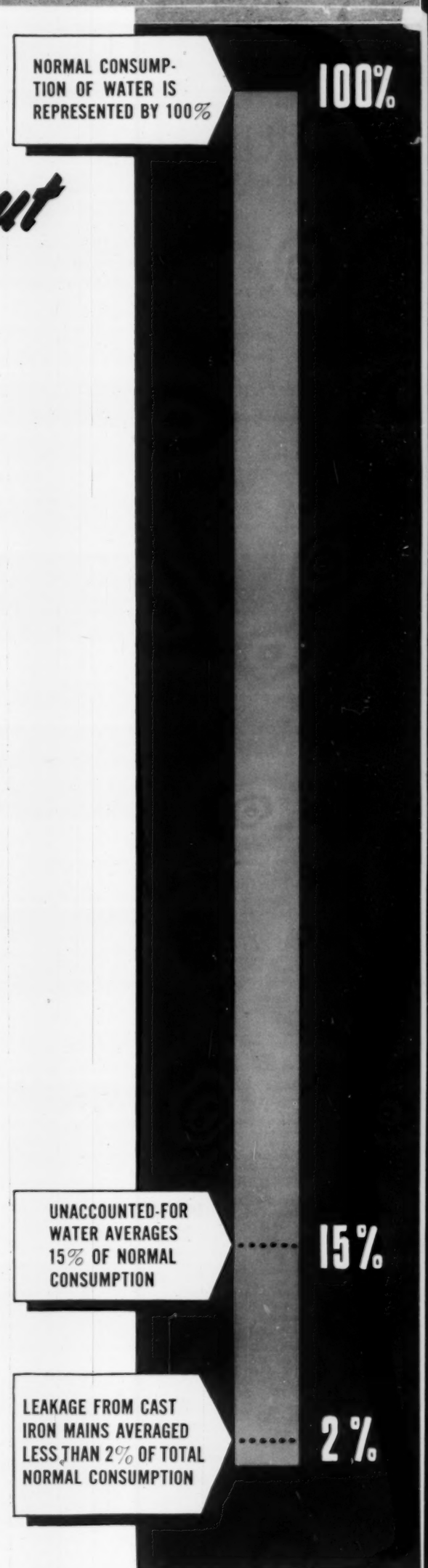
about nine-tenths of all unaccounted-for water must be attributed to causes other than leakage from cast iron water mains.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100%
UNACCOUNTED-FOR WATER AVERAGES 15% OF NORMAL CONSUMPTION
15%
LEAKAGE FROM CAST IRON MAINS AVERAGED LESS THAN 2% OF TOTAL NORMAL CONSUMPTION
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CURRENT PERIODICAL LITERATURE

Abstracts of Articles on Civil Engineering Subjects from Publications (Except Those of the American Society of Civil Engineers) in This Country and in Foreign Lands

Selected items for the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library, one of the leading technical libraries of the world. Some 2,000 technical publications from 40 countries in 20 languages are received by the Library and are read, abstracted, and indexed by trained engineers. With the information given in the items which follow, you may obtain the article from your own file, from your local library, or direct from the publisher. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page, plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

BRIDGES, HIGHWAY, QUEBEC. Bridge Building Progress in Province of Quebec, C. Milot. *Eng. & Contract Rec.*, vol. 52, no. 25, June 21, 1939, pp. 38–42. Descriptions of typical highway bridges constructed under jurisdiction of Quebec Department of Public Works.

BRIDGES, PONTOON. Concrete Pontoon Bridge—Review of Problems of Design and Construction, H. M. Hadley. *Western Construction News*, vol. 14, no. 9, Sept. 1939, pp. 293–298. Information on construction of Lake Washington Bridge, at Seattle, Wash., providing 4-lane highway crossing floating on 23 rigidly connected pontoon units, each 350 ft long; design details of typical pontoon of 4,558 tons; pontoon connection system; problem of wave action; anchorage system; load assumptions for determination of stresses; anchor cable attachment; concreting plant.

BRIDGES, STEEL TRUSS, WYOMING. Steel Bridge Modernizes Yellowstone Park Highway, J. W. Courter. *Western Construction News*, vol. 14, no. 9, Sept. 1939, pp. 303–304. Construction of highway bridge in Yellowstone National Park, crossing Gardiner River 201 ft above water level, consisting of four 184-ft steel deck trusses supported on three batter-leg steel towers, and two concrete U-type abutments; use of one of towers as temporary support during placing of steel for second of 184-ft spans.

CONCRETE, FRANCE. Le pont de Sainte-Marie-La Mer sur La Tet (Pyrenees Orientales), R. Godon. *Technique des Travaux*, vol. 15, no. 8, Aug. 1939, pp. 417–420. Design and construction of cantilever concrete bridge, consisting of 3 spans totaling 78 m in length, over Tet River, Southern France.

CONCRETE ARCH, STRESSES. Bridge Stresses Analyzed by Photoelastic Methods, C. Neufeld. *Eng. & Contract Rec.*, vol. 52, no. 24, June 14, 1939, pp. 13–15. Report from University of Saskatchewan on photoelastic study of bridge model for determining how closely designed distribution of steel in end block of bow string arch corresponded with actual lines of stress.

CONCRETE GIRDER, FRANCE. Reinforced Concrete Bridge Over Seine. *Civ. Eng.* (London), vol. 34, no. 398, Aug. 1939, p. 283. Design and construction of concrete girder highway bridge over Seine River at Villeneuve-Saint-Georges near Paris, France. Abstract of paper previously indexed from *Génie Civil*, July 1, 1939.

FLOORS. New and Unusual Upper Deck for Chicago's Michigan Ave. Bridge. *Eng. News-Rec.*, vol. 123, no. 19, Nov. 9, 1939, pp. 62–63. Construction of new wearing surface for floor of old Michigan Avenue bascule bridge in Chicago, Ill., consisting of asphalt plank laid on timber subflooring, except at end zones, where novel cast-iron grid filled with concrete is used because of excessive wear.

LIFT, WASHINGTON-IDAHO. Snake River Lift Bridge Links Washington-Idaho, R. W. Finke. *Western Construction News*, vol. 14, no. 8, Aug. 1939, pp. 267–269. Description of new steel-truss highway bridge over Snake River at Lewiston, Idaho, having total length of 1,423 ft and comprising 200-ft vertical lift span flanked on each side by 150-ft span built integral with counterweight towers; counterweight cable adjustment by special hydraulic-jack device; architectural treatment; cost estimates.

PLATE GIRDER, SWEDEN. Die neue Strassenbruecke ueber den Götaälv in Gothenburg, V. Hasselblad and D. Fuchs. *Bautechnik*, vol. 17, no. 26/27, June 23, 1939, pp. 353–371. Design and construction of new steel-girder highway bridge over Gotaalv at Gothenburg, Sweden, including bascule span 20 m long and totaling 950 m in length, ramp included; casting and sinking of bridge pier caissons.

STEEL TRUSS, CONSTRUCTION. Cantilever Method. *Construction Methods*, vol. 21, no. 9, Sept. 1939, pp. 42–45. Erection by cantilever method and closure of 300-ft main through-truss span of Meeker Avenue Bridge over Newton Creek, between boroughs of Brooklyn and Queens, New York City; truss halves pushed together for splicing at center by 500-ton hydraulic jacks.

WOODEN CONSTRUCTION. Economy of Treated Timber for Bridges and Culverts, J. Tate. *Eng. & Contract Rec.*, vol. 52, no. 21, May 24, 1939, pp. 66, 68, and 70. Merits of wood preservation in highway structures; composite timber; concrete design for bridges; creosoted timber culverts.

BUILDINGS

APARTMENT HOUSES, CONCRETE. Truck-Mixed Cinder Concrete. *Construction Methods & Equipment*, vol. 21, no. 7, July 1939, pp. 42–45. Methods used in construction of 51 apartment houses of Metropolitan Housing Project, in the Bronx (New York City); cinder concrete production; arch forms.

FOUNDATIONS, SUBSIDENCE. Building Settlement Checked Successfully, W. H. Wheeler. *Eng. News-Rec.*, vol. 123, no. 17, Oct. 26, 1939, pp. 45–47. Method of checking settlement of Dunwoody Industrial Institute building in Minneapolis by installation of underground framework carried on steel bearing piles outside building walls.

UNITED STATES. Portfolio of 1939 Buildings. *Eng. News-Rec.*, vol. 123, no. 17, Oct. 26, 1939, pp. 61–94. Symposium on building construction of 1939, including following: Insurance Office Building at Des Moines, L. A. McBroom; Tire Factory at Natchez, A. Tedesko; Apartment Housing, New York; Coffee Roasting Plant in Hoboken; Power Plant for Holland, Mich., R. F. Giffels; Automobile Press Shop at Detroit, A. Kahn; High School at Girardville, Pa.; Baking Soda Plant in Syracuse; City Hall and Auditorium for Topeka, R. A. Coolidge; Design and Drafting Offices in Chicago.

CONCRETE

AGGREGATES. Sand Blending, D. Dyrenforth. *Mines Mag.*, vol. 29, no. 8, Aug. 1939, pp. 413–415 and 425. Description of special equipment and processes for production of sand and other concrete aggregates used in construction of Grand Coulee Dam.

CONSTRUCTION, FORMS. Construction Design Chart—XLV, J. R. Griffith. *Western Construction News*, vol. 14, no. 9, Sept. 1939, p. 315. Construction of alinement chart for figuring out allowable loads on form shores 6 in. square.

CONSTRUCTION, PNEUMATIC CORE. Inflated Air Bags for Hollow Floor Construction. *Eng. & Contract Rec.*, vol. 52, no. 7, Feb. 15, 1939, pp. 7–10. Recent development in forming voids in concrete floors; use of canvas-covered rubber air bag instead of hollow tiles or blocks to form cavities, thus saving cost, weight, and labor; use of method for production of pre-cast reinforced concrete hollow columns, in lengths up to 15 ft.

CULVERTS. Monolithic Concrete Culvert Construction in Whittier, L. R. Abbott. *Am. City*, vol. 54, no. 10, Oct. 1939, pp. 56–57. Description of novel type of monolithic design for construction of 26,000 lin ft of arch-top culvert, varying in size from 18 in. to 5 ft 6 in., at Whittier, Calif.; culverts with pre-cast inner liners; advantages of arch-top type of culvert.

DISINTEGRATION. Concrete in Sulphate-Bearing Clays and Ground Waters. *Water & Water Eng.*, vol. 41, no. 515, Oct. 1939, pp. 518–519. Summary of observations on deterioration of concrete in sulfate-bearing soils and ground waters, effect of such factors as amount and nature of salts present, level of water table in ground and its seasonal variation, type and quality of concrete and form of construction involved.

ROADS AND STREETS. Stress-Cured Concrete Pavement, F. W. Russe, Jr. *Eng. News-Rec.*, vol. 123, no. 19, Nov. 9, 1939, pp. 68–69. Curing of road of pavement near Martinsburg, Mo., using rubber pressure cells in joints to place concrete pavement under end-wise compression; data on compressive strength of green concrete; method of construction; purpose of longitudinal compression.

DAMS

BLASTING. Drill Hole Size Tests at Hiwassee Dam, C. E. Blee. *Eng. News-Rec.*, vol. 123, no. 19, Nov. 9, 1939, p. 79. Description of well drills producing hole 9 in. in diameter used for blasting in quarry at Hiwassee Dam, N.C.

CONCRETE ARCH, WASHINGTON. Ross Dam Built in Isolated Skagit Gorge. *Eng. News-Rec.*, vol. 123, no. 15, Oct. 12, 1939, pp. 48–52. Report on first stage of construction of concrete gravity dam 225 ft high, with maximum ultimate height of 653 ft, for municipal hydroelectric power development of city of Seattle, Wash.; first stage of dam designed as variable radius arch; river diversion; preparation of aggregates and concrete; construction equipment and methods.

CONCRETE GRAVITY, CALIFORNIA. Construction Progress at Shasta Dam. *Eng. News-Rec.*, vol. 123, no. 19, Nov. 9, 1939, pp. 48–51. Progress report on first stage of construction of Shasta Dam of Central Valley Project in California, featuring foundation work, installation of concrete placing and material-handling equipment, excavation for railroad construction, etc.

CONCRETE GRAVITY, CALIFORNIA. Friant Dam Plans Provide Unusual Design Features, K. B. Keener. *Western Construction News*, vol. 14, no. 8, Aug. 1939, pp. 270–272. Specifications for construction of Friant Dam in California, maximum height about 300 ft; use of pumicite in mass concrete; precooling of concrete materials; variation in cooling pipe spacing; lining of concrete forms with absorptive materials; drainage; diversion of river.

CONCRETE GRAVITY, CALIFORNIA. Shasta Dam Radial Cableway System Featured by 460-Ft Head Tower. *Western Construction News*, vol. 14, no. 9, Sept. 1939, pp. 305–309. Review of design studies for concreting layout of Shasta Dam in California to handle 5,700,000 cu yd of concrete, which resulted in adoption of record-breaking 460-ft head tower, providing common support for ends of seven radial cableways covering entire dam and power-house area; layout of radial cableway system; design of head tower; design stresses; mixing plant.

CONSTRUCTION, WELDING. Bonneville Dam Presents Varied Use of Welding, P. L. Heslop and F. T. Downing. *Welding J.* (N.Y.), vol. 18, no. 10, Oct. 1939, pp. 604–609. Seven representative examples are described in detail to illustrate extent to which art of welding is employed in construction at Bonneville. Before Am. Welding Soc.

EARTH, WASHINGTON. Bids Called on Record Height Rolled Fill Dam for Flood Control in Washington. *Western Construction News*, vol. 14, no. 8, Aug. 1939, pp. 260–261. Principal features of earth fill dam, 420-ft high, to be built on White River near Tacoma, Wash.; river diversion plan; construction problems.

FOUNDATIONS. Artesian Water Pressure Lifts Dam, D. G. Thompson. *Eng. News-Rec.*, vol. 123, no. 15, Oct. 12, 1939, p. 73. Abstract of report before American Geophysical Union on effect of elasticity of water-bearing rock at Conchas Dam, N.Mex., where natural recharging of artesian foundation rock, following lowering of water table during construction, has caused dam to rise.

RESERVOIRS, GREAT BRITAIN. Design and Construction of Carron Reservoir, P. B. Glendin-

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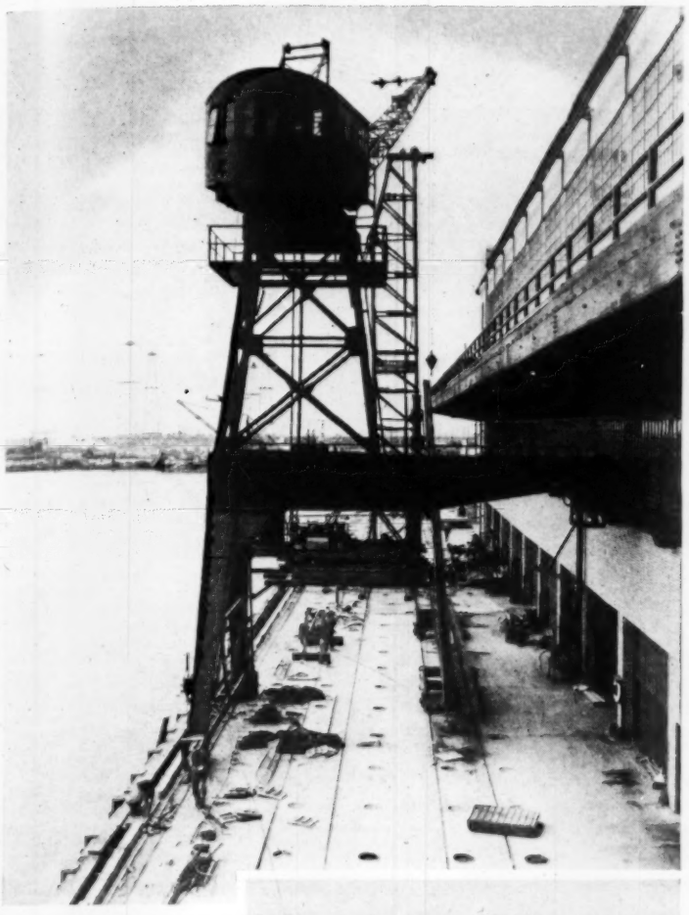
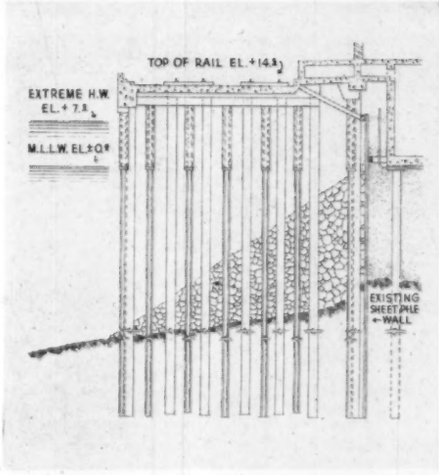


GENERAL VIEW OF OPERATIONS *showing cored holes on dock through which U·S·S Steel Bearing Piles were driven. In the background, note contractors driving equipment mounting Vulcan No. 0 hammer. Gantry crane in foreground, part of permanent plant equipment, was utilized for moving steel to driving rig. Piles averaged 75 ft. in length—this length was obtained by weld-splicing shorter sections in the field.*

Consulting Engineers: White & Squire, San Francisco. General Contractors: Tavares Construction Co., Los Angeles.



Over 40,000 lin. ft. of U·S·S Steel Bearing Piles provide safe, fast and economical foundation . . .

FOUNDATION engineers will find this wharf reconstruction for the Ford Motor Company plant at Long Beach, Calif., worth careful study.

How to reinforce the wharf and foundations for adjacent plant structures, menaced by the serious disintegration of the original material—and how to provide a strong, lasting and shock-resistant foundation without tying up plant and wharf facilities—were problems that called for unusual engineering skill and ingenuity.

The photographs and diagrams shown here illustrate how this job was handled—and completed to predetermined schedules without hitch or hold-up.

The U·S·S Steel Bearing Piles used in this underpinning (CBP-124 and CBP-103, weighing 74 lbs. and 57 lbs. per lineal foot respectively) averaged 75 feet in length, were driven with average penetration of from 40 to 50 feet, give estimated load-bearing value approximately 50 tons per pile. Many of these piles were driven through 25 feet of rock rip rap, without the use of driving points, and with no unusual difficulties.

Highly important was the relatively small size of these steel H-pile sections. Their small displacement permitted driving without any disturbance in the existing structure and made unnecessary the expense and trouble of removing the existing piles. On the wharf proper, holes were cored through the 3-foot thick concrete floor and through these the H-piles were driven. In all, 556 H-piles were driven on this project—total supported area 50,650 sq. ft. approx.

. . .

We are proud to add this interesting job to the long list of successful foundation structures in which U·S·S Steel Bearing Piles have proved their efficiency and economy. More than 4 million feet of these versatile wide-flange CBP Sections, especially designed for heavy pile use, have been driven in the past 4 years. We believe it will pay you to investigate them for your projects—especially when conditions are unusual.

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ning. *Surveyor*, vol. 95, no. 2471, June 2, 1939, pp. 721–723. Design and construction of water supply reservoir near Falkirk, Scotland, having storage capacity of 1,620 mg, formed by masonry dam of 42-ft maximum height and several clay core earth embankments; details of spillway and outlet channels. Before Instn. Water Engrs., Edinburgh.

RESERVOIRS, OUTLETS. San Gabriel Dam Outlet Tunnel Enlarged for Valve Chamber, P. Baumann. *Eng. News-Rec.*, vol. 123, no. 19, Nov. 9, 1939, p. 645. Method of construction of valve chamber for control works in outlet tunnel of San Gabriel Dam No. 1 by progressively cutting away lining and outer rock; anchor rings for tunnel plug cut at same time.

FLOOD CONTROL

OHIO. Small Area Runoff Studied, C. S. Bennett. *Eng. News-Rec.*, vol. 123, no. 15, Oct. 12, 1939, p. 56. Observations on flood discharge from 16-sq mile watershed of Brush Creek, in southwestern Ohio, which resulted in peak flow exceeding 845 cu ft per sec per sq mile.

FOUNDATIONS

BRIDGE PIERS. C. N. R. Uses 175-Ft. Steel Piles to Bridge Kinojevis River, E. J. Napier. *Can. Engr.*, vol. 76, no. 20, May 16, 1939, pp. 4–7. Methods used by Canadian National Railways in driving steel piles to approximate average depth of 175 ft below cutoff, and to maximum depth of 210 ft in construction of single-track 550-ft railway bridge over Kinojevis River.

BRIDGE PIERS. Driven Cylinder Foundations Built Rapidly. *Eng. News-Rec.*, vol. 123, no. 17, Oct. 26, 1939, pp. 55–57. Construction of foundations for three new lift bridges being built across Cuyahoga River in Cleveland, Ohio; 30-in. steel cylinders are being driven 150 ft through soft ground to rock, are socketed into rock and filled with concrete; foundation types; driving of cylinders; brace piles and sheeting.

BRIDGE PIERS. Probing for Bridge Foundations, N. R. Sack. *Eng. News-Rec.*, vol. 123, no. 15, Oct. 12, 1939, pp. 69–72. Practical methods and tools developed by Missouri State Highway Department for subsurface exploration for bridge foundations; tools and operating procedure; hand augers; sounding rods; churn drilling outfit; core drill practice; servicing equipment.

CONSOLIDATION. Die elektrochemische Bodenverfestigung, L. Casagrande. *Bautechnik*, vol. 17, no. 16, Apr. 14, 1939, pp. 228–230. Report on recent German laboratory and field tests of electrochemical methods of consolidation of clay soils by means of aluminum electrodes.

CONSTRUCTION. Clay Augers Sink Foundation Wells. *Eng. News-Rec.*, vol. 123, no. 15, Oct. 12, 1939, pp. 61–64. Method of sinking, with boring machines, of 200 shafts through 70 to 80 ft of clay and boulders to bed rock for Montgomery Ward and Company building in Chicago; placing lining in shafts.

DESIGN. Foundation Design, C. W. Steedman. *Surveyor*, vol. 95, no. 2468, May 12, 1939, pp. 629–632. Elementary theory of modern foundation design; deficiencies of traditional design; reactions of soil under load; stresses in foundation; bearing tests; shape of footings; effect of weak strata; settlement over long periods of time.

EARTH PRESSURE, MEASUREMENT. Erddruckmessungen bei mechanisch verdichteter Hinterfuellung von Stuetzkoerpern, P. Mueller. *Bautechnik*, vol. 17, no. 13, Mar. 28, 1939, pp. 195–203. Description of electro-acoustic apparatus and process for measuring earth pressure of mechanically compacted backfill behind retaining walls, showing that it is greater than pressure of non-compacted earth.

LANDSLIDES. Slips in Clay Banks, H. Chatley. *Engineering*, vol. 148, no. 3837, July 28, 1939, pp. 103–104. Theoretical mathematical study dealing with fundamental idea that surface of rupture in cohesive uniform material forming sloping bank is approximately cylindrical.

PILE. Fundamentals of Pile Foundations, I. F. Morrison. *Eng. J.*, vol. 22, no. 10, Oct. 1939, pp. 431–434. Comparative study of several types of pile foundations; reciprocal action between ground, piles, and structure supported by them; statics of single pile and of pile groups; pile-driving formulas.

PILE. Sulle Palificate di Fondazione, C. Cestelli. *Annali dei Lavori Pubblici*, vol. 77, no. 7, July 1939, pp. 5676–5684. Theoretical discussion of principles of design of pile foundations; stability of single pile and group of piles; formulas and tests of bearing power of piles.

PILES, CONCRETE. Reinforced Concrete Piling, F. E. Wentworth-Shields and W. S. Gray. London, Concrete Publications Ltd., 1938, 126 pp., figs., diagrs., tables, 8s 6d. Text on current British practice in designing, manufacturing, and driving reinforced concrete piles, including groups for bearing piles and sheeting piles, piles for anchorages and retaining walls, jetties and fenders; piling in sea water; specification for piles; cast-in-situ piles; forces and bending moments induced in certain reinforced concrete retaining walls; stresses during driving.

RAILROAD TURNTABLES. 125-Ft Turntables and 30-Stall Engine House Rest on Concrete Caissons. *Construction Methods*, vol. 21, no. 10, Oct. 1939, pp. 63–65, and 100. Construction of 125-ft turntables, one of largest in world, and 30-stall engine house resting on open caisson piers carried down to rock, at Harrisburg, Pa., for Pennsylvania Railroad Company.

RETAINING WALLS. Anchored Timber Bulkhead Supports Highway Fill. *Western Construction News*, vol. 14, no. 9, Sept. 1939, pp. 298–300. Construction of wall of treated timber backed by steel H-piles and tied to anchor piles under roadway fill of highway between Guerneville and Northwood in Sonoma County, Calif.; unit bid summary of retaining wall items.

HYDRAULIC ENGINEERING

COLLOIDS. Motion of Cylindrical Particles in Viscous Flow, R. C. Binder. *J. Applied Physics*, vol. 10, no. 10, Oct. 1939, pp. 711–713. Experiments were made on orientation of cylindrical particles in viscous flow; particles were immersed in moving fluid between two concentric cylinders; test showed two different final orientations; relations between final orientation and length-diameter ratio of particle was found for different speeds; comparison is made between experimental results and theoretical predictions.

SPILLWAYS, MODEL TESTING. Model Tests Furnish Design Data for Stilling Basin Reconstruction, C. A. Lauenstein. *Western Construction News*, vol. 14, no. 10, Oct. 1939, pp. 327–332. Report on tests of 1:40 model of spillway and stilling basin of Calaveras Dam, for water supply of San Francisco, Calif., to determine hydraulic improvements for lower end of spillway and for stilling basin being reconstructed after partial failure of February 1938; cantilever wall design for stilling basin; details of stilling basin design, results of model tests.

HYDROLOGY AND METEOROLOGY

BEACHES, EROSION. Coast Erosion, W. Melville. *Surveyor*, vol. 95, no. 2474, June 23, 1939, pp. 817–819, (discussion) 823. Discussion of direction of littoral drift and design of groins and seawalls; types of groins; damage caused by sea defences. Before Instn. Mun. & County Engrs.

EROSION, CONTROL. Coastal Erosion in Victoria, A. D. Mackenzie. *Instn. Engrs. Australia—J.*, vol. 11, no. 7, July 1939, pp. 229–236. Observations on erosion of shores subject to marine and other influences; application of protective measures thereto, having particular regard to foreshores of Port Phillip Bay, Victoria, Australia.

PENNSYLVANIA. Report of Cooperative Hydrologic Investigations. Commonwealth of Pennsylvania Dept. Forests & Waters, 1939. 168 pp., illus., maps, diagrs., tables, charts. Progress report on study of hydrology of Pennsylvania; establishment of new continuous records of precipitation and stream flow data; inauguration of modern river forcasting service; recording rainfall stations; transmission of data and dissemination of forecasts; unit basin analysis; unit hydrographs; rainfall and runoff relations; multiple basin analyses; forecasting procedure; elevations of major floods in Pennsylvania.

RAIN AND RAINFALL. Rainfall and Discharge Records for Northern Iowa Drainage Districts, W. J. Schlick. *Iowa State College—Eng., Experiment Station—Bul. 141*, vol. 37, no. 51, May 1939, 72 pp., supp. plates. Study of rainfall and drainage discharge to determine rates of runoff for which drainage districts in northern Iowa should be designed; changes which extensions of farm lateral systems produce in discharge characteristics of such districts; field data include rainfall and discharge records for period, 1920 to 1932; frequency studies of rainfall and of peak rates of runoff.

INLAND WATERWAYS

RIVERS, CHINA. Bijdrage tot een beter begrip van eenige markante eigenschappen der Gele Rivier, H. van der Veen. *Ingenieur*, vol. 54, no. 40, Oct. 6, 1939, pp. B.157–164. Contribution to better understanding of some remarkable characteristics of Yellow River in China; measurement of discharge and silt load; chemical analysis of loess; supplement to article published in 1934 issue of same journal.

RIVERS, REVETMENTS. Soil-Cement Revetment Moves. *Eng. News-Rec.*, vol. 123, no. 15, Oct. 12, 1939, p. 53. Satisfactory performance of cement-stabilized earth in sacks used for river bank revetment at Ft. Brown, Tex., in course of subsidence and river-ward movement of as much as 5 ft which followed summer floods.

IRRIGATION

CANALS, SIPHONS. Construction of New River Crossing. *Reclamation Era*, vol. 29, no. 7, July 1939, pp. 172–176. Description of All-American Canal crossing on old flood channel of Colorado River, by means of inverted siphon, composed of two parallel 186-in.-diameter welded plate steel pipes, each 374 ft long; regulating gates; hauling and installing equipment.

CANALS, SIPHONS. Equipment Speeds Siphon Work, J. C. Coyle. *Eng. News-Rec.*, vol. 123, no. 19, Nov. 9, 1939, pp. 73–75. Description of methods and mechanical equipment used in con-

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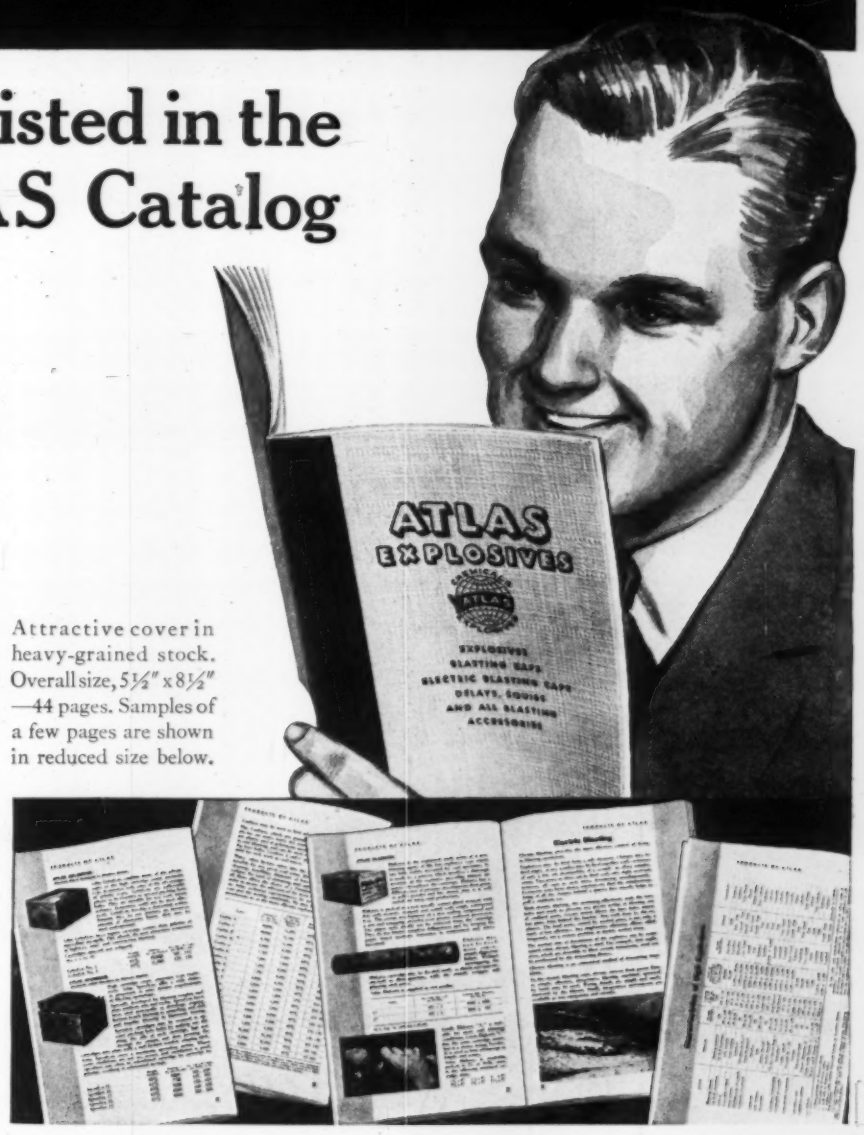

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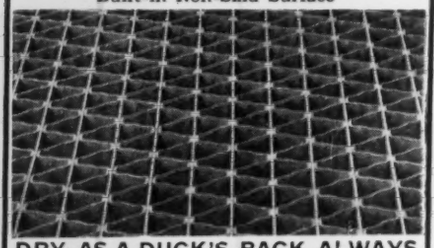

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FRANCE. Assainissement de la Plaine de l'Isere, H. Sautelet. *Travaux*, vol. 23, no. 81, Sept. 1939, pp. 351–360. Description of recent drainage project near Grenoble, in southern France, involving earthwork and tunnel construction; well point system used in lowering water table of Isere River valley.

SILT CONTROL. Imperial Dam and Desilting Works on Colorado River. *Engineering*, vol. 148, no. 3841, Aug. 25, 1939, pp. 225–227 and 230, supp. plates. Illustrated description of one of projects authorized by Boulder Canyon Act of 1928 to improve utility of Colorado River; dam, employed to divert water from river into canal some 80 miles long, to provide for irrigation of Imperial Valley, is of slab-and-buttress type, 3,450 ft long; canal with capacity of 6,000 cu ft per sec will be used for irrigation of 150,000 acres of desert near Yuma, Ariz.

MATERIALS TESTING

CEMENT. Einbauversuche mit 18 Zementen auf der Reichsautobahn bei Berlin, K. Eberle. *VDI Zeit*, vol. 83, no. 39, Sept. 30, 1939, pp. 1080–1082. Construction tests with 18 kinds of cement on superhighway near Berlin; tests to determine influence of chemical and mineral composition and fineness of cement on quality of road surface; analysis of results.

CONCRETE AGGREGATES. Selection of Aggregates for Concrete Pavement Based on Service Records, C. Cantrill and L. Campbell. *Crushed Stone J.*, vol. 14, no. 4, July-Aug. 1939, pp. 3–8. Service records of various aggregates are presented as indicated by concrete pavement condition survey; purpose of investigation was to determine aggregates having unsatisfactory service records and standard tests which would eliminate future use of those aggregates. Before Am. Soc. Testing Materials.

MUNICIPAL ENGINEERING

PARKS, ACCIDENT PREVENTION. New York's Safety Program for Its Parks, A. R. Jennings. *Safety*, vol. 26, no. 10, Oct. 1939, pp. 239–240. During past 5 years City Park Department has been engaged in expansion of park and recreation facilities; program has been twofold—first, to provide relief from strain and disorder to harried inhabitants of city, and second, to take people off streets; equipment safeguards; building safety into roads.

PORTS AND MARITIME STRUCTURES

AFRICA. L'état actuel du port de Dakar. *Génie Civil*, vol. 115, nos. 2981 and 2982, Sept. 30, 1939, pp. 265–269, and Oct. 7, pp. 280–282. Description of port of Dakar on west coast of Africa, with special reference to new breakwater and piers; statistical data on commerce and industries of Dakar; Dakar lighthouses; airport of Dakar.

AUSTRALIA. Construction of Mackay Harbour, R. M. Butler. *Civ. Eng.* (London), vol. 34, no. 398, Aug. 1939, pp. 307–308. Development of modern port of Mackay on eastern coast of Queensland, Australia, at estimated cost of £1,500,000.

CALIFORNIA. Built-to-Order Harbor Begun at Inshore End. *Eng. News-Rec.*, vol. 123, no. 15, Oct. 12, 1939, pp. 65–66. Features of artificial harbor being developed at Point Hueneme, near Oxnard, Calif.

SHORE PROTECTION, GREAT BRITAIN. Coast Defence at Sunderland, R. S. Cogdon. *Civ. Eng.* (London), vol. 34, no. 396, June 1939, pp. 214–216. Methods used in construction of mass concrete groin 360 ft long, with cope 9 ft wide; structure below high water mark is made up of pre-cast concrete blocks 4 ft by 4 ft by 3 ft wide.

ROADS AND STREETS

BITUMINOUS. Analysis of Failures and Defects of Bituminous Surfaces, C. E. Beland. *Technique*, vol. 14, no. 7, Oct. 1939, pp. 493–496 and 512. It is concluded that most failures or unsatisfactory results in bituminous construction will be prevented if dry, sound, well graded, and hydrophobic aggregate is combined with right type of high quality bituminous binder.

BRICK. Brick for Street Gutters and Parking Strips. *Eng. & Contract. Rec.*, vol. 52, no. 10, Mar. 8, 1939, pp. 9–11. Data supplied by National Paving Brick Assn. on use of vitrified paving brick to give stability and long life to sections of pavements adjoining curbs; advantages of brick gutters; details of construction of brick parking strip and brick gutter.

CAUSEWAYS. FLORIDA. Florida Railroad Bridges Revamped to Carry Overseas Highway, B. Benson. *Construction Methods & Equipment*, vol. 21, nos. 7 and 8, July 1939, pp. 68–70, 96, 98, and 100, and Aug., pp. 61–63, 100, and 102. Construction of overseas highway on concrete arch railroad bridges; discussion of unusual working conditions and field methods on Florida Keys project; reconstruction and widening of concrete arch, steel deck-plate girder, and steel through-truss bridges.

CONSTRUCTION. American Roadbuilding in Liberia, A. N. Carter. *Eng. News-Rec.*, vol. 123, no. 15, Oct. 12, 1939, pp. 67–68. Report on primitive road construction by Firestone Tire & Rubber Co in developing its 100,000-acre rubber plantations in Liberia.

CONSTRUCTION. Grading Pennsylvania Turnpike, C. S. Hill. *Eng. News-Rec.*, vol. 123, no. 13, Sept. 28, 1939, pp. 42–45. Description of heavy grading and paving work on 161 miles of Pennsylvania Turnpike on site of abandoned South Penn Railway.

CONSTRUCTION. Stabilized Base Construction on Mississippi's Route 15, A. B. Covell. *Roads & Streets*, vol. 82, no. 9, Sept. 1939, pp. 23–29. Construction of two sections of asphalt-stabilized base 33 miles long; character and design of surface; moisture and its control; preparing windrow; making stabilized mix; base finishing operations; surface finish; inspection and control; equipment and organization.

CURVES. Bugbear of Spirals, C. C. Wiley. *Eng. News-Rec.*, vol. 123, no. 11, Sept. 14, 1939, pp. 84–85. Analysis of effect of spiral on behavior of vehicle and process of steering; simple method of computing spirals.

DESIGN. Design of Roads, R. G. H. Clements. *Engineering*, vol. 148, no. 3843, Sept. 8, 1939, pp. 289–292; see also abstract and discussion in *Engineer*, vol. 168, no. 4366, Sept. 15, 1939, pp. 273–274. Design considered in three principal phases: Design of national road system for future needs; structure and its supplementary features; and traffic function—that is, economic and mechanical advantage, safety, and development of this public service. Before Sec. G of Brit. Assn.

HIGHWAY ADMINISTRATION, FINANCING. Toll Roads and Free Roads. *Crushed Stone J.*, vol. 14, no. 3, May-June 1939, pp. 3–10. Analysis of report of Public Roads Administration, prepared by National Highway Users Conference; feasibility of transcontinental toll road system investigated; master plan for free highway development presented.

INTERSECTIONS. Die Bauwerke der Reichsautobahnstrecke Ingolstadt—Muenchen, W. Haussmann. *Bautechnik*, vol. 17, no. 17, Apr. 21, 1939, pp. 237–241. Design and construction of several types of grade-separation structures along new superhighway between Ingolstadt and Munich, Germany.

INTERSECTIONS. Grade Separation at Thomas Circle. *Eng. News-Rec.*, vol. 123, no. 19, Nov. 9, 1939, pp. 55–57. Construction of grade separation structures at Thomas Circle in Washington, D.C., consisting principally of reinforced concrete box along Massachusetts Avenue providing two separated 21-ft roadways; planning of construction operations for minimum interference with flow of traffic.

INTERSECTIONS. Median Strips at Highway Intersections. *Eng. News-Rec.*, vol. 123, no. 17, Oct. 26, 1939, pp. 48–51. Analysis of new design problems at intersections of four-lane highways due to increasing use of median strips; design for left turns; limiting factors in designing width of median strip for safe left and U-turns at divided highway intersections; openings for narrow strips; shape of ends of median strips.

INTERSECTIONS. Washington Revises Its Famous Circles, H. C. Whitehurst. *Eng. News-Rec.*, vol. 123, no. 17, Oct. 26, 1939, pp. 42–44. Redesign of circle intersections in streets of Washington, D.C., to eliminate traffic congestion and delays.

MACHINERY, GRADERS. Road Graders. *Steel*, vol. 105, no. 7, Aug. 14, 1939, pp. 52, 54, and 74. Road graders, rollers, and other heavy road-building equipment, manufactured from standard plates and shapes which are formed and assembled by welding.

MAINTENANCE AND REPAIR. Program of Crack Sealing to Save Asphalt Pavement, C. R. Blood. *Western Construction News*, vol. 14, no. 8, Aug. 1939, pp. 265–267. Author's procedure, involving use of asphaltic emulsions at 40-lb pressure, to repair cracks in thin asphaltic wearing surfaces covering concrete base.

PENNSYLVANIA. Pennsylvania Turnpike Issue. *Roads & Streets*, vol. 82, no. 10, Oct. 1939, pp. 33–108. Symposium on financing, design, and construction of 160-mile superhighway from Harrisburg to Pittsburgh, Pa., utilizing right of way of old South Penn Railroad, to cost $61,000,000; Evolution of Pennsylvania Superhighway; Financing Turnpike, W. A. Jones; Designing Roadway; Tunnel Design; Construction Paces Progress Schedule;

RAILROAD CROSSINGS, ELIMINATION. Victoria Park Avenue Subway, Toronto, F. S. Hutton. *Can. Engr.*, vol. 76, no. 18, May 2, 1939, pp. 4–8. Description of typical Canadian National Railways' new design of grade separation structures, embodying unusual features, such as exceptionally long and shallow concrete girders and track construction without ties or ballast; temporary railway diversion.

RAILROAD CROSSINGS, SIGNALS AND SIGNALING. Highway Crossing Signals on Reading. *Ry. Signaling*, vol. 32, no. 10, Oct. 1939, pp. 544–546. Highway grade crossing protection installed on

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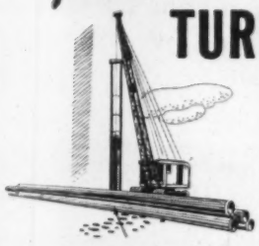

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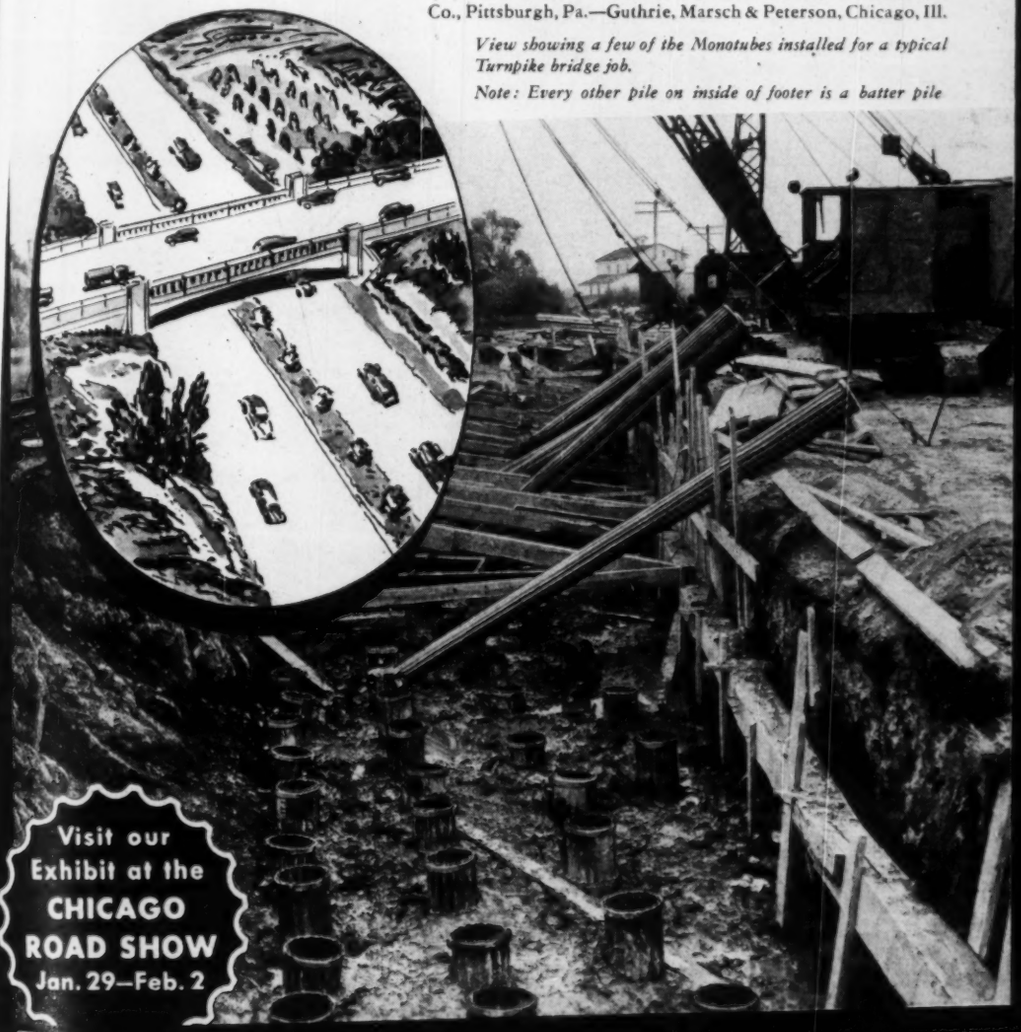

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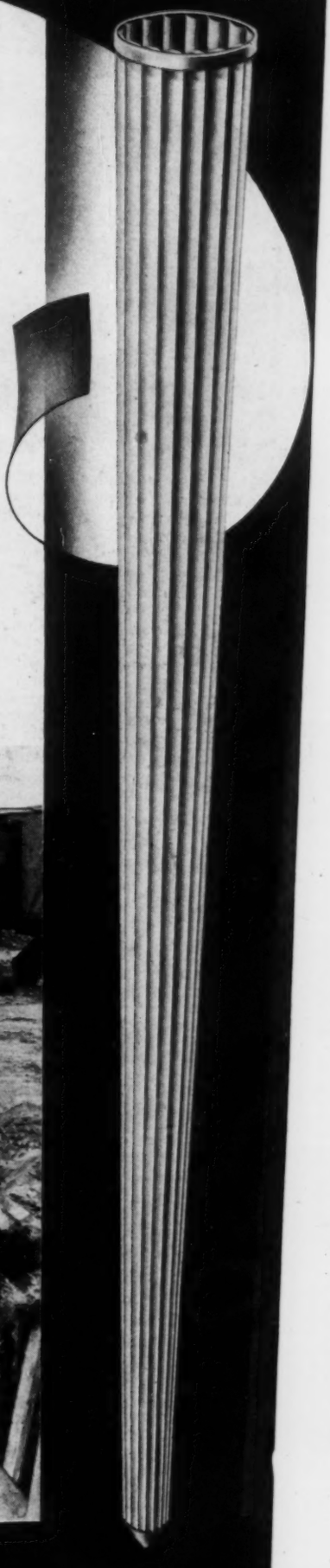

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The Macmillan Company, New York

single-track line extending from Reading Railroad's main line at Birdsboro, Pa., to Wilmington Del.; automatically operated flasher signal protection at 8 crossings, manually controlled short gate arms supplemented by flashing light signals at one crossing, and provision of modern and additional protective equipment at six crossings, installed.

STATE AID. State Aids Road Building in Maine by Day Labor, L. D. Barrows. *Roads & Streets*, vol. 82, no. 9, Sept. 1939, pp. 33–37. Distribution of highway funds by fiscal years; designs used; equipment arrangement; wages and equipment rental rates; comparative average unit costs; average contract prices; cost analysis for 1935 construction of state-aid and third-class roads.

VISION. Seeing Low Contrasts at Night, M. Luckiesh and F. K. Moss. *Light & Lighting*, vol. 32, no. 8, Aug. 1939, pp. 165–166. Since most hazards which exist upon streets and highways at night are large in size and low in contrast, latter factor is of basic importance; ability of motor vehicle drivers and others to distinguish low contrasts is factor of corresponding importance from viewpoint of safety; various aspects of problem are dealt with.

SEWERAGE AND SEWAGE DISPOSAL

CHEMICAL PROCESS. Chemical Coagulation of Sewage—XI, H. W. Gehm. *Sewage Works J.*, vol. 11, no. 5, Sept. 1939, pp. 738–751. Effect of soluble matter on coagulation; specific causes of chemical requirements in coagulation of sewage and reasons for variations in coagulant demand; effect of fine suspended solids and soluble sewage substances on coagulant demand; effect of pure compounds; effect of urine on coagulant demand; effect of ferric chloride on B.O.D. of sewage. Bibliography.

GRIT CHAMBERS. Unique Solution for Grit Chamber Design, C. E. Barnes. *Water Works & Sewerage*, vol. 86, no. 9, Sept. 1939, pp. 369–373. Solution for grit chamber design incorporated in sewage treatment plant improvements for Lakewood, Ohio; selection of dimensions for control section; preliminary calculations on rating curve; model tests; effect of submergence.

PLANTS, CAIRO, EGYPT. Sewage Disposal System of Cairo, C. Hammerton. *Surveyor*, vol. 95, nos. 2468 and 2475, May 12, 1939, pp. 619–620, and (discussion) June 30, pp. 853–855. Sewage disposal system of Cairo, Egypt, and description of its present status. Abstract of paper before Inst. Sewage Purification.

PLANTS, IOWA. Iowa's Famed Region of Lakes Gets Comprehensive Sewage Disposal System, A. W. Von Struve. *Water Works & Sewerage*, vol. 86, no. 8, Aug. 1939, pp. 307–309. Description of new sewage disposal system in region of Great Lakes near Iowa—Minnesota boundary, including 8.7 miles of trunk line, 4 pumping stations, and compressed air, activated-sludge, sewage-treatment plant.

PLANTS, LAKEWOOD, OHIO. Sewage Treatment Plant of Lakewood, Ohio, R. F. MacDowell. *Water Works & Sewerage*, vol. 86, no. 9, Sept. 1939, pp. 350–353. Features of design and operation of new sewage disposal plant serving population of 75,000, capacity 17.2 mgd; Imhoff tanks; separate sludge digestion tanks; sewage chlorination.

PLANTS, NEW JERSEY. Unusual Sewage Plant Operation. *Eng. News-Rec.*, vol. 123, no. 15, Oct. 12, 1939, pp. 57–60. Review of 2-year operation of joint meeting of sewerage disposal plant serving 12 communities in northern New Jersey; new information on pumping concentrated sludge through long pipe line; experiences with Mieder traveling bridge sludge collector; operating problems; plant performance and treatment costs; flow diagram and layout of disposal works; discharging sludge at sea from barge.

SEWERS, CONSTRUCTION. Glasgow Main Drainage, J. M. Riddet. *Civ. Eng.* (London), vol. 34, no. 399, Sept. 1939, pp. 320–322. Construction of concrete and brick sewers 7 miles long, diameter ranging from 3 ft to 8 ft 6 in., for sewerage system of Glasgow, Scotland; special design for elliptical sewer crossing Forth and Clyde canal; methods used in overcoming difficult ground conditions; details of special cast iron working shaft and breakaway, built under compressed air, from vertical lock in shaft.

SEWERS, MAINTENANCE AND REPAIR. Cast Iron Liner Plates Protect Sewer from Erosion. *Eng. News-Rec.*, vol. 123, no. 19, Nov. 9, 1939, p. 52. Repairing worn-out invert of 48-in. cast iron sewers at New Orleans, La., with cast iron plates fastened to inside of main surface with wrought iron pins.

SLUDGE. Sludge Filtration, L. W. Van Kleeck. *Water Works & Sewerage*, vol. 86, nos. 8 and 10, Aug. 1939, pp. 310–313, and Oct., pp. 415–419. Laboratory control of sludge filtration; tests for specific gravity, solids, pH, and for filtering rates; Buchner funnel tests; records for filter operation; vacuum filter data on four types of sludge; filtration of raw and digested primary sludges; future design of vacuum filter layouts; feeding and storage of chemicals; sludge concentration; sludge conditioning tanks; location of filter exhausts; safety measures. (Concluded.)

STRUCTURAL ENGINEERING

COLUMNS, STEEL. Steel-Angle Columns. *Construction Methods*, vol. 21, no. 9, Sept. 1939, pp. 46–47 and 92. Advantages of utilizing steel angles for all columns in skeleton frames of five 8-story fireproof apartment houses in Park Terrace Gardens, New York City.

CONCRETE SLABS, TESTING. Tests of Reinforced Concrete Slabs Subjected to Concentrated Loads, F. E. Richart and R. W. Kluge. *Univ. Ill. Eng. Experiment Station—Bul.*, vol. 36, no. 85, June 20, 1939, 75 pp. Test forming part of investigation of reinforced concrete slabs subjected to concentrated loads, to secure information needed for more effective design of highway bridge floor slabs; differences between measured and calculated quantities; effect of size and shape of bearing area; consistency of slab behavior; tests of long rectangular slabs simply supported on two long edges; tests of square slabs.

CULVERTS, STEEL. Steel "Bridges." *Steel*, vol. 105, no. 13, Sept. 25, 1939, pp. 54 and 56. Materials and methods employed in punching and forming heavy steel culvert sections; corrugating and punching done together on one machine with automatic feed; second machine accurately forms desired curvature.

ROOFS, ARCH. Arch-Rib Roofs. *Steel*, vol. 105, no. 13, Sept. 25, 1939, pp. 148 and 150. Use of special fabricated beams made up of sections joined by welding to form arch rib roof; excellent structure produced and no supporting columns necessary; economical in material and construction costs.

TRUSSES, VIERENDEEL. Ein Annaeherungsverfahren zur Berechnung des Vierendeeltraegers, etc. O. Braun. *Stahlbau* (Supp. to *Bautechnik*), vol. 12, nos. 9 and 11, Apr. 28, 1939, pp. 69–74, and May 26, pp. 86–92. Outline of approximate methods of design of Vierendeel trusses of any cross-section and loading conditions, taking into account elasticity of upright trusses; numerical examples.

TUNNELS

SUBWAY CONSTRUCTION, CHICAGO. Chicago Digs Subway, H. E. Fleming. *Transit J.*, vol. 83, no. 11, Oct. 1939, pp. 408–409 and 428–429. Construction work goes forward in face of difficulties in negotiations for unification of surface, elevated, and bus properties; estimated total cost without equipment, now stands at $46,000,000; details of construction; design followed is that of low level tunnels, with tubes horseshoe shaped or circular; walls are of concrete reinforced with steel.

VEHICULAR CONCRETE LINING. Betontechniek bij den Maastunnelbouw te Rotterdam, J. P. Van Bruggen. *Ingenieur*, vol. 54, no. 35, Sept. 1, 1939, pp. Bt. 67–75. Concrete construction in Meuse River tunnel in Rotterdam; changes in original design; waterproofing and airproofing; finishing of concrete surfaces with tiles; concrete piles; construction control.

VEHICULAR, LINING. Important Tunnel Lining Study. *Eng. News-Rec.*, vol. 128, no. 15, Oct. 12, 1939, pp. 72–73. Report on condition of lining consisting of porcelain-enamel steel tile after 9-year service in Detroit tunnel walls; tile shows no corrosion except where knocks have chipped enamel; use of timber furring recommended instead of attaching tile directly to concrete.

VEHICULAR, NETHERLANDS. De Maastunnel te Rotterdam, J. P. Van Bruggen. *Ingenieur*, vol. 54, no. 41, Oct. 13, 1939, pp. B. 165–181. Definitive report on design and construction of Meuse River vehicular tunnel at Rotterdam, Netherlands, including parallel pedestrian tunnel; launching and sinking of caissons used in tunnel construction; ventilating systems; escalators.

VEHICULAR, SUBAQUEOUS. Projet de tunnel routier sous La Mariche, A. Laisnel. *Génie Civil*, vol. 115, no. 2983, Oct. 14, 1939, pp. 292–295. Discussion of two new schemes for construction of vehicular tunnels 45.5 km to 49.5 km under English Channel between Calais and Dover or Marquise and Folkestone.

VENTILATION. New York Vehicular Tunnel Is Automatically Ventilated. *Heating & Vent.*, vol. 36, no. 10, Oct. 1939, pp. 44–45. Description of unusual combination time clock and carbon monoxide control system installed in New York Vehicular Tunnel.

WATER PUMPING PLANTS

DIESEL. Diesels Make Irrigation Cheaper, G. D. Crossley. *Diesel Progress*, vol. 5, no. 10, Oct. 1939, pp. 29–31. Various Diesel pumping units as used by farmers around flat, treeless, sun-baked sections of Colorado, are described.

WATER TREATMENT

ANALYSIS, LABORATORIES. New Building for Mt. Prospect Laboratory, F. E. Hale. *Water Works Eng.*, vol. 92, no. 22, Oct. 25, 1939, pp. 1362–1365. Description of new building and equipment of Mt. Prospect Laboratory of New York City Water Department; résumé of laboratory research on life of typhoid bacteria, candle turbidimeter, bile media, etc.